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The Actinolite

FOR THE TREATMENT OF DISEASE BY ACTINIC LIGHT

WITH THE RECENT
LITERATURE OF
ACTINO - THERAPEUSIS

KLIEGL BROS.
1393-1395 Broadway and 129 West 38th Street
NEW YORK

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The Actinolite

THE lack of a simple and thoroughly efficient apparatus for actinotherapy has prevented the more general employment of the radiant energy of the ultra-violet portion of the spectrum for therapeutic purposes. Its value in suitable cases has been testified to by numerous observers both in this country and abroad; but none of the several types of phototherapeutic apparatus hitherto available is free from very serious defects which limit and in some cases entirely prevent the proper application of the force. The inventors and manufacturers of the ACTINOLITE have finally succeeded in constructing an apparatus in which all the theoretical errors and practical limitations are avoided, and which they believe to be mechanically and phototherapeutically perfect.

Some idea of the difficulties attendant upon the construction of the apparatus may be gained from the fact that not less than seventeen models have been successively tried before the present patterns were developed; and that the aid of the most noted European and American optical and electrical laboratories has been invoked to ensure perfection of its individual parts. Every principle and feature that theory and practise have shown to be valuable are embodied in it.

A perusal of the following short treatise upon photo-chemics and the apparatus necessary for its employment will, we think, demonstrate the fact that the ACTINOLITE is not only the most perfect instrument of its kind, but is the only one from which results proportionate to the amount of energy employed can be obtained.

In the appendix we give the indications for the employment of the new force, so far as they have been worked out by competent investigators, together with literature and abstracts upon the general subject of actinotherapy. The entire absence of any general résumé of the subject in English medical literature and the impossibility of the practitioner consulting the scattered articles in various languages for himself is shown by the numerous inquiries on the subject which the Messrs. Kliegl continually receive. They therefore hope that this portion of the monograph will be especially acceptable to the many investigators of this new and promising therapeutic field. They would lay stress upon the fact, however, that as yet comparatively little has been done; and they believe that, in placing an effective instrument at the disposal of the medical profession, they open a wide field of usefulness for the method in the alleviation and cure of disease.

The Phototherapeutic Apparatus

While all the appreciable rays of the spectrum induce some chemical action, it is a well-known fact that the blue, violet, and ultra-violet are the most powerful, in the order mentioned. Not only does the chemical activity of the rays decrease with great rapidity as we approach the red end of the spectrum, but the heat rays increase so greatly in amount that their employment in concentrated form would cauterize the tissues, and must therefore be avoided. The perfect phototherapeutic machine, therefore, must not only produce the maximum quantity of violet and ultra-violet rays, but must also be so arranged that the red heat rays are as far as possible excluded. The energy produced by the machine must be collected over as large an angle as possible, freed as much as may be from the injurious heat rays, and then directed and focused upon the area to be treated. For these purposes condensers and baths are necessary; but it is quite immaterial in what order collection, condensation, and heat elimination is effected. A phototherapeutic apparatus must therefore consist of three essential parts: an energy producing arrangement, a collecting, condensing and focusing system, and a heat absorbing device.

The Source of Light

The sun is the most powerful and the cheapest source of phototherapeutic energy; but it is not available, save under exceptional circumstances, for various reasons. Chief of these is the fact that it cannot be relied upon for continuous service, and its use in our temperate zone would be restricted to a few hours upon certain days. For reasons that will be apparent later, it could only be employed in the open air, which further limits its sphere. Then again the solar spectrum is so full of absorption bands that some of its rays are very small in quantity; the earth's atmosphere is a great absorbent of the ultra-violet rays, and this action becomes enormous in the miles of air through which the sun's rays reach us; and, finally, the apparatus required to utilize them is complicated and cumbersome.

None of the forms of light obtained from gas or oil is worthy of any consideration at all for actinotherapeutic purposes. Their actinic energy is so extremely low that no increase in size or multiplication in number gives them the necessary activity; while, on the other hand, the quantity of heat rays they emit is very great.

The light of the electric bulb is also useless, though mistakenly employed in certain forms of apparatus. The incandescent filament is comparatively cold, and its spectrum ceases in a very low region. The amount of energy that the lamps consume is small. The average 16 c. p. lamp takes only half an ampere and the 100 c. p. lamp not more than three amperes. It does not mend matters to combine numbers of these lamps, so as to utilize more current; for, while the intensity of the light may be heightened, the spectrum is not changed. Under these circumstances there is of course increased area of the focus of light distribution, necessarily accompanied by increased loss by air rarefaction and absorption, and enhanced difficulties of collection and condensation; all of which disadvantages nullify the gains from increased intensity of the light. Over and above all this, the light is enclosed in a glass globe—a condition which, as we shall see later, entirely deprives it of value for our purpose. Apparatus consisting of arrangements of incandescent bulbs may be valuable for the application of heat and the induction of sweating, but they are useless for actinotherapeusis.

The electric arc is the most powerful artificial light producing agent at our command, and the only one that can compare with sunlight in activity. Its intensity and its spectrum show its tremendous energy and chemical activity, and it is so superior to all the others in these important respects that comparisons with other sources of artificial light are entirely useless. The ordinary arc light gives a remarkably even spectrum, with a good strong ultra-violet region; and the energy produced is directly proportional to the square of the current employed. In fact at short distances the energy of the electric arc and the amount of violet and ultra-violet rays that it produces are proportionately greater than those of sunlight. It is therefore not only the only artificial light suited to actinotherapeutic purposes, but is eminently adapted for this use.

The spectroscopic character of any given arc light depends to a certain extent upon the nature of the electrodes employed, since it is by the incandescence of their fragments that light waves are produced. Carbon, giving a preponderant amount of the yellow visual rays, is very properly the material employed for the electrodes of ordinary arcs intended for illuminating purposes. But there are other elements whose spectra are very much stronger in the blue, violet, and ultra-violet regions; and notably magnesium, potassium, and iron. Plain iron or steel electrodes have been tried both here and abroad; but it has been found impossible to

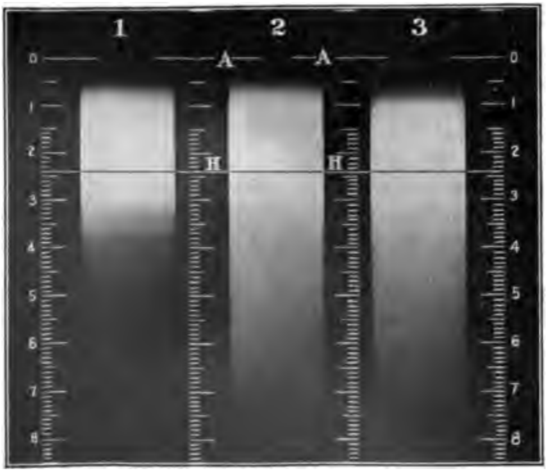

FIG. 1.

1. **Spectrum from ordinary carbon electrode.**
2. **Spectrum from new chemical electrodes.**
3. **Spectrum from iron electrodes.**

The A and H lines are drawn in to show their positions.

maintain the arc for longer than a minute or two; the metal composing the electrodes fuses and runs away; and finally, the conductivity of the metal is so great that the entire apparatus becomes rapidly superheated. Cooling the electrodes by means of currents of water running through them has been tried; but it has not thus far been found practical to produce an arc of more than three amperes capacity on this plan; the lamps so made are complicated, unsatisfactory, expensive, and the results are incomplete for want of power. We are now able, however, to supply electrodes containing the above metals combined with carbon, which burn similarly to the pure carbons in ordinary use, and give a very much greater quantity of the useful actinic rays. Fig. 1 shows the comparative spectra of the new electrodes containing these substances and of the ordinary carbons, and will at once show the very great superiority of the former.

The Collecting and Condensing Apparatus

The interposition of glass is well known to be fatal to the usefulness of a machine whose object is the production and transmission of the chemical rays of light. It was long ago discovered that the spectrum obtained by means of the reflecting diffraction grating or of a rock crystal prism showed a powerful and extended actinic region, invisible to eyesight and beyond the violet, whose very existence had not been suspected in the days when glass prisms alone were employed for spectroscopic purposes. This is the ultra-violet ray region, now known to be by far the most powerful in chemical effect of the entire parcel of rays. Until very recently all kinds of glass have been absolutely impervious to most of the ultra-violet rays; and even in the other regions they are so little pervious to anything but the yellow and green rays that they might be and are called yellow and green glass. The very whitest specimens of ordinary glass are open to this criticism. The finest specimens of optical glass show an enormous absorption in all regions but the yellow, when examined spectroscopically; and it is no wonder that they have been found therapeutically inefficient, even when powerful arcs of as high a capacity as 100 amperes are employed.

Rock crystal has in the past been the only substance known which would transmit what is known as a full spectrum. But rock crystal is rare and expensive, and does not occur in sufficiently large masses. Lenses over three inches in diameter are not obtainable commercially. The problem of obtaining an optical material for the condensers and cooling apparatus which would not absorb almost all the rays that we desire to employ seemed well-nigh insoluble.

It has now, however, for the first time, been successfully dealt with. We now possess a glass flux which transmits the whole of the blue, violet, and ultra-violet rays. And it does even more than this; it actually extinguishes so great a proportion of the yellow, orange, red, and infra-red rays that it transmits a comparatively cool light. Plates and discs of any desired size can be made of it. By its use a scientifically correct and practically useful phototherapeutic apparatus can be made, and any desired amount of light force can be employed. It is not too much to say that this new medium places the entire subject of phototherapeutics upon a new and most hopeful basis.

Reflectors and refractors are the two types of apparatus by means of which the rays of light coming from a given source can be concentrated and turned in any desired direction. On the basis of extended practical experimentation as well as of theoretical considerations, the manufacturers of the ACTINOLITE have come to the conclusion that the method by reflection, the best known example of which is the ordinary searchlight, is entirely inapplicable to machines destined for phototherapeutic use. The difficulties in the construction of satisfactory reflectors have been found practically insuperable. Thus when glass reflectors of the ordinary kinds are used the light has to pass through this material twice at least before reaching the object, and all the objections to its employment are doubled. The cost of producing perfect metallic reflectors is prohibitive; it is impossible to keep the surface in proper optical condition, and it would need skilled attention after each exposure to the light. The most serious fault of the reflector, however, lies in the fact that the two ends of the spectrum are focused in identically the same plane, so that it is almost impossible to properly separate the heat from the chemical rays. Even when this is done by water in the most approved fashion, as will be detailed below, the quantity employed must be enormously great; and even then the heat rays are entirely too abundant to permit of anything like a satisfactory concentration of the beam of light.

With the refraction method, on the other hand, where an uncorrected system of lenses is employed, the dispersion of focus is sufficiently great to allow the placing of the patient directly in the chemical focus. The few heat rays still outstanding after the ray is cooled are in focus beyond it, and do not affect the surface treated. Fig. 2 explains this. Here A is the light and B and R respectively the foci of the blue and red regions. At the blue focus the light appears a bluish-white with a circular spectrum consisting of concentric bands of color surrounding the center, and with the red upon the outside. The central darker region is the invisible ultra-violet which we aim to employ. Many of the mechanical difficulties that are insuperable in the reflecting apparatus are entirely absent in the reflecting form, and all the practical phototherapeutic apparatuses, including Finsen's original models, are made on that plan.

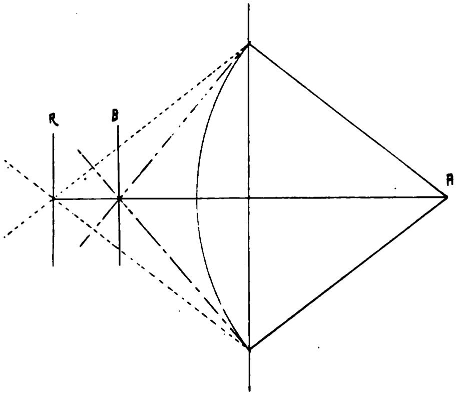

Fig. 2.

B. Blue focus.
R. Red focus.

The collecting lens of a phototherapeutic apparatus should have a focal length which is amply sufficient to prevent the heat of the lamp from damaging the lens. The lamp should be placed in the principal focus of the lens, thus ensuring the transmission of parallel rays. For a given focal length the volume of the rays transmitted will depend, within certain limits, on the diameter of the lens. Fig. 3 will make this statement somewhat plainer.

A is the source of light, and B B′, C C′, and D D′, are lenses of the same focal lengths, but of different diameters.

Fig. 4 shows the limits beyond which the diameter of the lens cannot be usefully increased. There is a minimal distance at which the arc can be placed without cracking or otherwise injuring the lens, and this is chosen for the focal length. As the diameter of the lens increases the angle A increases; and upon the size of this angle depends the volume of light that is utilized. When

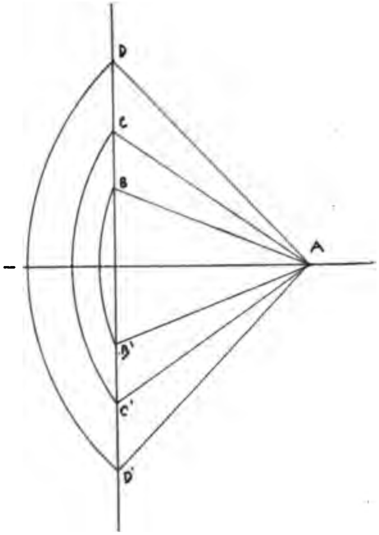

FIG. 3.

the angle D A D′ reaches a certain degree (depending in each case upon the refractive index of the material of which the lens is composed), called the "critical angle," the light ceases to enter the lens, and is reflected as by a mirror. This angle limits the angle A; and it has been found with rock crystal and the new pervious glass that, placing the arc as near to the lens as safety will permit, the greatest obtainable angle at A is 73 degrees.

The arc must be so arranged that the crater of the positive carbon, whence most of the light emanates, shines directly into the lens. A reference to Fig. 5 will explain this. The center of the crater must also be in the optical axis and at the principal focus of the collecting lens. In this way all the available light rays in their greatest intensity are rendered parallel, and can then be condensed, cooled, and focused, as may be found desirable.

It will thus be seen that for an efficient phototherapeutic apparatus the lenses must be made of rock crystal or some substance equally diaphanous to the ultra-violet rays, and that the use of glass is fatal to its efficiency; that the source of light should be at a distance from the lens, which bears exactly that ratio to its diameter as will ensure the obtaining of as great a numerical aperture as the refractive index of the medium employed will permit without passing the "critical angle"; and that that distance should coincide with the focal length of the lens. Any increase of diameter of the lens beyond the point of total reflection is of

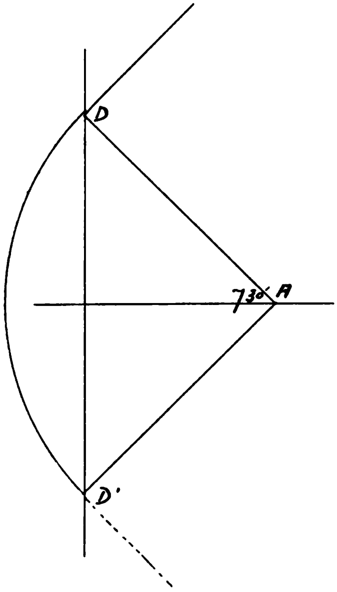

FIG. 4.

course useless. In some forms of apparatus now upon the market the angle is increased by shortening the distance from the light to its destination, and dispensing with the collecting and condensing apparatus. While this has in a measure cheapened the apparatus, it leaves the machine with several disadvantages that render it very inefficient. The greatest angle obtainable by this method is approximately 40 degrees; and this means a ratio of numerical aperture to that of 73 of about 35 : 60, or slightly more than half. Then again the limit of energy that can be employed in these lamps is somewhere about 8 amperes; and as the energy produced by the arc is proportional to the square of the current strength, it bears a ratio to a lamp of, say, 80 amperes, of about 64 : 6400. Even were it possible to obtain the same angle or numerical aperture as can be got with the large condensing lenses, the great difference in energy would render them comparatively weak. It is not surprising, therefore, if machines of this type are found wanting in efficiency in practice.

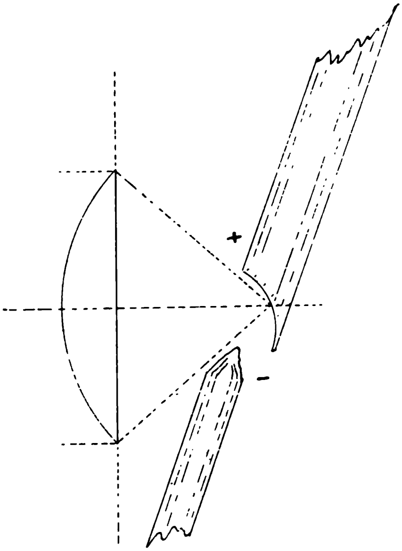

FIG. 5.

The Cooling Device

The problem of separating as many of the heat rays as possible from the aggregate energy of the electric arc and preventing their projection upon and into the body is of the greatest importance. It has been solved in various ways. For a long time certain operators have been in the habit of employing blue glass screens for the purpose, with the idea of absorbing the infra-red, red, orange, and green rays, and transmitting only the blue. They were probably not aware that the actinic action of the blue rays is quite insignificant as compared with that of the violet and ultra-violet regions of the spectrum, and that it is the chemical action of these latter upon organic compounds that is the effect desired. That the use of blue glass for this purpose is fundamentally erroneous follows from the acknowledged fact, above referred to, that all ordinary glass, apart from its color, absorbs almost the entire amount of the chemical rays. The effect of the interposition of a blue glass screen will be evident from the accompanying illustration (Fig. 6). Here is figured a continuous spectrum from the electric arc with the chemical electrodes and one from the same source after the light has traversed a blue glass screen from one of the machines now on the market. It will be seen at once that not only does the blue glass absorb the greater portion of the infra-red and the red, but also all of the ultra-violet and almost if not all the violet; and not only this, it absorbs an enormous portion of the blue itself. Hence any cooling device based upon this principle defeats the very object for which the light is employed.

Arrangements consisting of a cell containing water are more successful; for water very largely absorbs the heat rays, and at the same time transmits the chemical ones in almost undiminished activity. Thicknesses of water up to about 20 inches transmit these latter rays almost conpletely, and so greatly diminish the heat rays that the light is almost cold. The great difficulty with this method has been to obtain a container whose transparent sides will not absorb the actinic rays. Finsen, as is well known, employs a long water tube closed at each end with rock crystal lenses. Apart from the impossibility, already referred to, of obtaining such lenses in any but the very smallest sizes, it has been found in practise that the expansion and contraction of larger lenses under the influence of the heat of the arc is so great that leakage cannot be prevented. The method is practical only for small machines having lenses of four inches diameter or less.

Now that we have obtained a glass which is as transparent to the actinic rays as the rock crystal itself, however, the difficulty of cooling the rays has disappeared. Cells of various shapes and sizes, containing whatever amount of water may be required, can be made. Provision for evaporation greatly aids in keeping the water cool; and where the machine is to be employed for long periods of time, a continuous water circulation apparatus should be used.

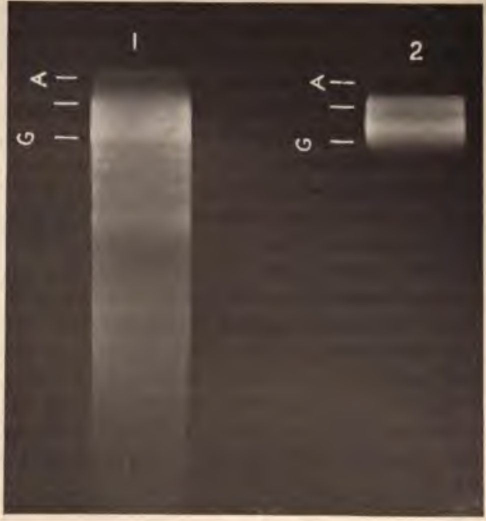

FIG. 6.

1. Spectrum of chemical carbon.
2. Absorption spectrum of blue glass.

The machines in which iron electrodes are cooled by the circulation of water inside them are necessarily limited to instruments of such insignificant dimensions and capacities that they need hardly be considered. Two or three amperes is their limit, it not being possible to cool larger electrodes in this manner.

From time to time the addition of various dyestuffs to the water of the bath has been recommended, in the hope that they would help the absorption of the heat rays. In every case, however, the chemical ray absorption has been found to be too great. Increased heat absorption can only be got by increasing the amount of water, or arranging for its constant renewal by circulation.

Ice has been proposed as an absorbent of the heat rays, and small slabs of that material may be useful under special circumstances. The rapidity of its melting, however, and the inconvenience from dripping, prevent its employment in the larger machines.

Compressors of various kinds are sometimes used to express the blood from the part to be treated, and so heighten the actinic effect of the rays. These can now be supplied either plain or curved, and made of the new transparent optical medium.

The mechanical construction of the machine for actinotherapeusis is a matter of minor importance; but the apparatus should be simple and convenient, so that it can be readily placed in any position and the light projected in any direction, and so that it should not be liable to get out of order. The movable parts should be finely adjusted and balanced; but steadiness should not be sacrificed, and strong set screws for every motion will be found advantageous.

Résumé

From the foregoing it follows that a really serviceable phototherapeutic apparatus must fulfill the following conditions:

1. It must be supplied with light by artificial means.
2. The light must be as powerful as possible, since no arrangements of condensers or reflectors will coax power out of a feeble lamp.
3. The electrodes should be chemically prepared so as to produce a spectrum especially rich in ultra-violet rays.
4. Incandescent lamps, of whatever size or design, are useless for actinotherapy.
5. The refracting principle of condensation, and not the reflecting, must be employed.
6. Condensing and collecting lenses should be as large as possible, and should be made of rock crystal or some other material equally diaphanous to the chemical rays.

7. The cooling apparatus should consist of a layer of distilled water containing no other substance, and sufficiently thick to absorb most of the heat rays. It should be enclosed in a vessel which does not interfere with the transmission of the chemical rays.

8. The machine should be mounted in such a way as to enable the operator to adjust and direct it with the greatest degree of nicety.

The Actinolite

THE ACTINOLITE combines in the highest attainable degree every good quality that theory demands and that mechanical possibilities admit of. The aim throughout has been to produce a machine as nearly approaching the ideal one for actinotherapeusis as is possible. The most powerful arcs, the strongest lenses, the most diaphanous media, the highest degree of mechanical perfection, the utmost facility of range and adjustment, are its special features.

THE MACHINE consists of a fireproof Russia iron barrel, in front of which are mounted the collecting and condensing lenses, and also the cooling arrangement, and back of which is the fire box containing the arc light. The barrel is mounted upon a swivel and trunnion, worked by a circular rack and pinion, thus admitting of the finest possible adjustment. The whole is mounted upon a base containing all the necessary resistance; so that the machine need only be connected with the regular mains, and is absolutely complete in itself. The resistance in the rheostat is finely graduated, so that from one half to the full capacity of the light may be used by simply turning a lever over a finely graduated dial upon the marble base board. The entire machine is mounted upon casters which permit it to be moved about the office with the greatest facility.

THE LENSES are made of the newly invented glass, which is at present the only substance outside of rock crystal that transmits the chemical rays. This material is of the extremest hardness, and requires two months in the annealing. Slabs of it ten inches in width have been tested spectroscopically, sending the light edgewise through their entire width, and have been found to transmit the chemical rays just as well as rock crystal; in fact, rock crystal possesses no advantages over our new glass, and cannot be obtained

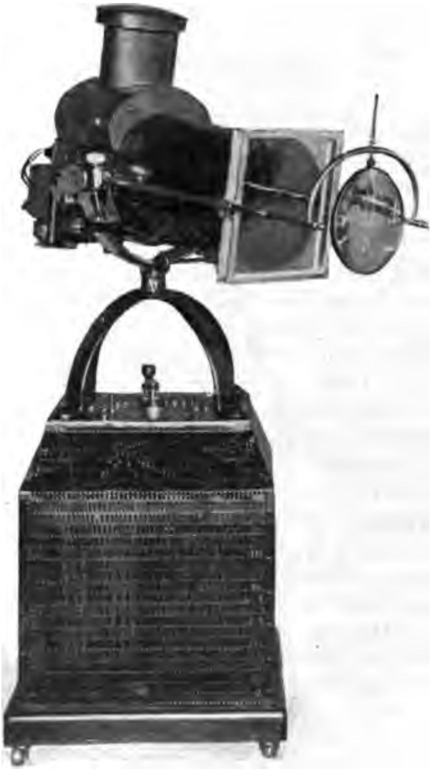

FIG. 7.

No. 1 Actinolite.

Showing Auxiliary Lens in position.

rosewood. The whole is enclosed in an enameled iron case pr with many perforations for the free circulation of air.

THE CARBONS are of the special chemical type, giving large arc and a light that is excessively rich in violet and violet rays.

They have been perfected after a long series of experi made to determine which combinations of chemical sub would produce the best average of all of the qualities requi this type of machine. A good carbon must give the ma amount of ultra-violet rays and at the same time burn slow evenly, and it is of the first importance that it should not b too greatly. Our carbons approach in the highest possible all of these requirements. They are manufactured by o process and formulae, and we confidently recommend them best that can be obtained.

Where the current is from ninety to one hundred vol Actinolites may be used in series, simultaneously, at th current cost as one machine. The second Actinolite ta place of the rheostat. On higher voltages one Actinolite operated on every 45 volts. When it is desired to do this, h the number of machines to be run and the exact voltage n specified when ordering, so that the resistance may be p adjusted.

One important point in connection with the machine d especial mention. In any arc light almost all the light directly from the crater; and therefore in machines buil the Finsen type, in which the light is projected into tubes on sides of the arc, each tube can only receive a very small por the total energy developed at any one time. Hence the ve longed exposures and the great length of time that is requi treatment. In the Actinolite the crater is turned directly collecting lens, and all the available light is concentrated u patient. Hence the exposures are greatly shortened, even the same amperage is employed; and this is necessaril more the case when the Actinolite is compared with the s machines of insignificant power. This means economy of c and time, and greatly increased practical efficiency. Th so far at our disposal show that the time required for tre is only a fraction of that needed with the elaborate and Finsen apparatus. Sessions of fifteen minutes give a reaction

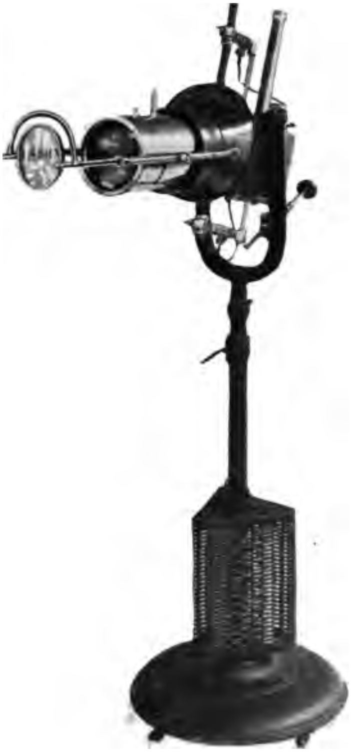

FIG. 9.

No. 3 Actinolite.

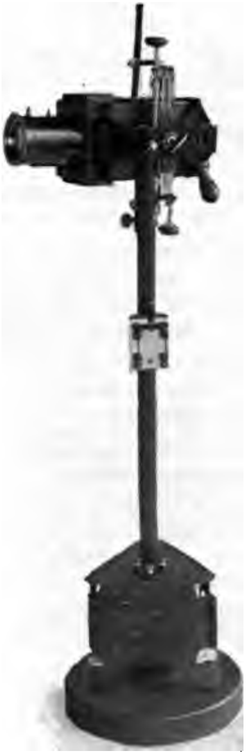

FIG. 10.

No. 4 Actinolite.

to that obtained with the older machine in an hour or more, and the entire time of treatment is correspondingly abridged.

ACTINOLITES are made in four sizes. Nos. 1 and 2 are suitable for the treatment of the internal organs as well as the skin; Nos. 3 and 4 are recommended for cutaneous affections only.

No. 4 has been designed to meet the demand for an apparatus that can be connected with the regular incandescent wiring of an office, and is a compact and valuable apparatus for use in dermatology. The machine is complete in itself and need only be connected up with the source of current. It is enameled black with gold striping and design. Hand feed arc light of our especial pattern, nickelplated, knife switch, and three yards of cable.

No. 3 is a larger machine than the preceding, and is useful where it is designed to get quicker results.

This machine is furnished in the same style as the foregoing with the exception that the rheostat is capable of adjustment by a sliding handle. The lamp is of the automatic type, and it is furnished with a screw adjustment for directing the light. There is no switch upon the machine.

In both of these machines the water bath is combined with the lens barrel.

No. 2 is the most generally popular machine, and has been used more than any other. All the experimental work with the Actinolite has been done with this size. It is excellent for dermatological practise, and is sufficiently powerful for the treatment of affections of the internal organs. Furnished in black enamel with gold lining and design. Automatic arc light, highly nickeled and polished. Rheostat in base, enclosed in perforated iron casing mounted on polished hardwood platform.

No. 1 is the largest machine of its kind in the world, and is recommended for use in hospitals and sanatoria where a great many internal cases are treated. It gives results very much more quickly than the others. This machine is finished almost exactly like the preceding, with the exception that the arc light is of the hand feed type. It is of our own design and is capable of the very finest adjustments of the carbons and arc.

In Nos. 1 and 2 a separate water bath is furnished.

Directions

For Actinolites Nos. 1 and 2

LAMP ADJUSTMENT.—To adjust the lamp, loosen the set screw on the supporting rod beneath the fork and the double set screws on each side of the fork; the light may be focused in any desired direction by the lever.

THE LENSES.—The lenses within the hood are adjusted in focus by means of a worm screw under the barrel. To focus the auxiliary lens, loosen the set screws at the end of the projecting rods, and draw out the movable rods until the double convex condensing lens at the end gives the desired diameter. The adjustment of the focal spot may also be regulated by moving the patient to or away from the lens as the case may require. The nearer the lens is approached, the greater the area of the focal spot.

THE WATER BATH.—The reservoir, which is placed in front of the condensing lens on the stationary rods, is intended to absorb the heat rays, and should be filled with distilled water.

THE CARBONS.—The carbons used in the No. 1 ACTINOLITE are 1⅛″ top cored, ⅞″ solid bottom. No. 2 ACTINOLITE, ¾″ cored top, 9-16″ cored bottom. The upper carbon is positive and should be cored and the lower one negative and should be solid. If on switching on the current the greatest light should appear on the lower carbon, the polarity is reversed and the plug should be removed from the switch board and turned so that the greatest light appears on the upper carbon, which should always be the positive pole. In inserting new carbons, the negative or lower carbon should project about an eighth of an inch in front of the upper or positive carbon.

FEEDING.—The lamps are of the automatic self feeding pattern, and practically require no adjustment. In the No. 1 they are adjusted by hand. By placing the finger under the small arm of the upper carbon holder and raising it, the carbons are separated. The switching on of the current starts the automatic action and the carbons continue to feed themselves until they are exhausted. They may also be adjusted or fed by hand by pressing the button to the right of the rack supporting the upper carbon holder.

THE RHEOSTAT.—The rheostat is placed at the top of the stand. When the handle is resting on first button the resistance is all in, and but 25 amperes in No. 2 and 55 amperes in No. 1 is allowed to pass through. By raising the handle the current is increased until it reaches its maximum strength, which is 55 amperes in No. 2, 100 amperes in No. 1.

CARE OF THE LENSES.—Care should be taken to prevent a draught of cold air reaching the lenses after they are heated. After use, a woolen cloth should be thrown over the apparatus. The lenses themselves, and especially the lens surface nearest the carbons, should be kept scrupulously clean.

For Actinolite No. 3

The Stand.—To raise, lower, or turn the lamp, loosen the set screw in the stem, exercising care that when the lamp is adjusted the set screw is tightened sufficiently to prevent dropping.

Lamp Adjustment.—To adjust the lamp, turn the worm screw below the arc case.

The Lenses.—To focus the light, loosen the set screws at sides of lens reservoir, and draw out the lens until the double convex condensing lens at the end gives the desired diameter of light area. The adjustment of the focal spot may also be regulated by moving the patient to or away from the lens as the case may require. The nearer the lens is approached, the greater the area of the focal spot.

The Water Bath. The reservoir lens, which is placed on the stationary rods, is intended to absorb the heat rays. To prepare the reservoir, fill with water, and adjust the conducting pipe over the nozzle at the bottom of the reservoir. Allow the water to run until the reservoir is filled and overflows at the nozzle at the top, and then adjust the conducting pipe to sink.

The Carbons. The carbons used in the No. 3 Actinolite are ⅝" in diameter top, ½" in diameter bottom. The upper carbon is positive and should be cored, and the lower one negative and should be solid. In alternating arc they are ⅝" cored top and bottom. If on switching on the current the greatest light should appear on the lower carbon, the polarity is reversed, and the plug should be removed from the switchboard and turned so that the greatest light appears on the upper carbon, which should always be the positive pole. In inserting new carbons, the negative or lower carbon should project about an eighth of an inch in front of the upper or positive carbon.

Feeding. The lamps are of automatic self feeding pattern, and practically require no adjustment. By placing the finger under the small arm of the upper carbon holder and raising it, the carbons are separated. The switching on of the current starts the automatic action and the carbons continue to feed themselves until they are exhausted. They may also be adjusted or fed by hand by pressing the button to the right of the rack supporting the upper carbon holder.

Treatment.—In giving treatment, all clothing should be removed from the parts to be acted upon and the light focused over the area. The intensity is governed by the patient's toleration.

The Rheostat.—The rheostat is placed at the bottom of the stand. When the handle is pressed down to its extreme limit the resistance is all in, and but 25 amperes are allowed to pass through. By raising the handle the current is increased until it reaches its maximum strength, which is 35 amperes.

Efficiency of Light.—The efficiency of the light ranges from 30,000 to 40,000 candle power, depending on the amount of current employed. By increasing the amperage the efficiency of the light is also increased.

Care of Lenses.—The heat from the arc is necessarily absorbed into the lens to a certain extent. Therefore, immediately after each treatment, a cloth of wool or asbestos should be thrown over the lens in the hood and at the extremity of the rods and kept in that position until the lenses are thoroughly cool. The utmost care should be exercised to prevent a draught from blowing on the lenses, as a sudden rush of cool air on them when they are heated is liable to cause them to crack.

For Actinolite No. 4

THE STAND.—To raise, lower, or turn the lamp, loosen the set screw in the stem, exercising care that when the lamp is adjusted the set screw is tightened sufficiently to prevent dropping.

LAMP ADJUSTMENT.—To adjust the lamp, loosen the set screw which holds hand feed lamp, and by moving the lamp back or forward you will bring the arc in focus of lenses.

Each carbon holder can again be adjusted by itself.

THE LENSES.—The lenses in front of the hood are adjusted in focus with the light and are not movable. The adjustment of the focal spot may be regulated by moving the patient to or away from the lens as the case may require. The nearer the lamp is approached the lens, the greater the area of the focal spot.

THE WATER BATH.—The reservoir, which is placed between the condensing lenses, is intended to absorb the heat rays. To prepare the reservoir, adjust the conducting pipe over the nozzle at the bottom of the reservoir. Allow the water to run until the reservoir is filled and overflows at the nozzle at the top and then adjust the conducting pipe to the sink over it.

THE CARBONS.—The carbons used in the No. 4 ACTINOLITE are ½″ top cored, 7-16″ bottom solid. The upper carbon is positive and should be cored, and the lower one negative and should be solid. If on switching on the current the greatest light should appear on the lower carbon, the polarity is reversed and the plug should be removed from the switch board and turned so that the greatest light appears on the upper carbon, which should always be the positive pole. In inserting new carbons, the negative or lower carbon should project about an eighth of an inch in front of the upper or positive carbon.

FEEDING.—The lamps are of the hand feeding pattern. By turning the feed screw to right or left the carbons are approached or separated at will.

TREATMENT.—In giving treatment, all clothing should be removed from the parts to be acted upon and the light focused over the area. The intensity is governed by the patient's toleration.

THE RHEOSTAT.—The rheostat is placed at the bottom of the stand and is of a fixed capacity of 10 amperes.

CARE OF LENSES.—The heat from the arc is necessarily absorbed into the lens to a certain extent. Therefore, immediately after each treatment, a cloth of wool or asbestos should be thrown over the lens in the hood and at the extremity of the rods and kept in that position until the lenses are thoroughly cool. The utmost care should be exercised to prevent a draught from blowing on the lenses, as a sudden rush of cool air on them when they are heated is liable to cause them to crack.

Prices

The following table gives the particulars of the machines:

No.	Capacity		Lenses. Diam.	Weight, Boxed. Pounds.	Price.
	Volts.	Amperes.			
1	110	55 to 100	10	500	$500 00
2	110	25 to 55	8	325	300 00
3	110	20 to 30	6	160.	200 00
4	110	10	3	90	100 00

For current of higher voltages than 110, extra resistance is required. We also furnish this at lowest prices, which will be given on application.

The prices are boxed, f. o. b., New York, and include 5 yards of cable and one dozen pair of our new ultra-violet electrodes.

IN ORDERING it is necessary to state whether the current is direct or alternating, number of alternations, if alternating, and the exact voltage on which the ACTINOLITE is to be run.

Prices of Supplies and Parts of Actinolites

All previous prices are herewith canceled.
Prices subject to change without notice.

LENSES.

	Price Each
For No. 4 Actinolite, 3″ Lenses, U. V. Glass...........	$15 00
“ 3 “ 6″ “ “ “	25 00
“ 2 “ 8″ “ “ “	50 00
“ 1 “ 10″ “ “ “	75 00

AUXILIARY LENSES FOR USE WHERE IT IS REQUIRED TO CONDENSE THE LIGHT OVER A VERY SMALL AREA.

Prices, complete, mounted in nickeled frame, with nickeled focusing rods:

	Price Each
For No. 3 Actinolite, 6″ Lenses, U. V. Glass...........	$30 00
“ 2 “ 8″ “ “ “	55 00
“ 1 “ 10″ “ “ “	80 00

COMPRESSORS.

Mounted in nickeled ring, complete, with silk elastic band. These compressors may be sterilized.

	Price Each
No. 1—Free space, 1¾″.............................	$7 50
“ 2— “ “ 2½″.............................	9 00

BLUE FLAME CARBONS.

These are a special chemical carbon calculated to produce a light containing more chemical rays than any other known source.

CARBONS FOR ALTERNATING CURRENT.

			Price per 100
For No. 4 Actinolite,	½″ x 12″,	Cored Top and Bottom...	$6 62
“ 3 “	⅝″ x 12″,	“ “ “ “ ...	10 00
“ 2 “	¾″ x 12″,	“ “ “ “ ...	12 91
“ 1 “	1⅛″ x 12″,	“ “ “ “ ...	26 24

BLUE FLAME CARBONS FOR DIRECT CURRENT.

				Per 1,000	Per 100
For No. 4	Cored	Positive Top,	½″ x 12″	$62 66	$7 23
Actinolite,	“	Negative Bottom,	7–16″ x 9″	46 15	5 32
For No. 3	“	Positive Top,	⅝″ x 12″	95 00	10 00
Actinolite,	“	Negative Bottom,	½″ x 9″	55 20	6 27
For No. 2	“	Positive Top,	¾″ x 12″	111 98	12 91
Actinolite,	“	Negative Bottom,	⅝″ x 8″	57 40	6 62
For No. 1	“	Positive Top,	1⅛″ x 12″	227 17	26 24
Actinolite,	“	Negative Bottom,	⅞″ x 9″	110 89	12 79

WATER BATHS, COMPLETE, WITH SPECIAL U. V. GLASS, SAME AS USED IN LENSES. HIGHLY POLISHED.

		Price Complete
For No. 3 Actinolite,	6″ x 8″........................	$30 00
“ 2 “	8″ x 10″.......................	35 00
“ 1 “	10″ x 12″......................	45 00

EXTRA PLATES OF U. V. GLASS FOR WATER BATHS.

		Price Each
For No. 3 Actinolite,	6″ x 8″........................	$10 00
“ 2 “	8″ x 10″.......................	12 00
“ 1 “	10″ x 12″......................	15 00

The Actinic Arc Light Bath

Arc light baths have been extensively employed on the continent of Europe for the purpose of exposing the entire body to concentrated actinic rays, but until the present no efficient apparatus for the purpose has been upon the American market.

The bath here illustrated embraces every known improvement and is based on thoroughly scientific principles. It is an instrument devised for the application of actinic rays, combined with heat and ozone, and is especially suited to the treatment of tuberculosis and other diseases of the respiratory tract and general skin affections. It embodies the following advantageous features:

1. Each section being separate and movable, the entire apparatus can be taken apart and packed in a small space.
2. When the parts are assembled, and the instrument is in working order, it is entirely portable, and may be moved to any part of the room.
3. The entire interior of the cabinet, including fillings, mattress, etc., can be cleansed and asepticized. The mattress and pillow coverings can be washed with the ordinary antiseptic solutions.
4. The temperature in the cabinet is registered on a thermometer outside, and by means of the ventilating device, may be perfectly regulated.
5. The doors are adjustable, and so arranged that the cabinet may be completely closed, or left partly or entirely open.
6. The arc lamps are of the automatic pattern and are furnished with spark protectors of actinic glass, which prevent all trouble from sparking.
7. Each lamp is of ten amperes capacity and is completely under control at the rheostat.
8. Through the sliding panel in the door the patient may be watched, and by its means access is obtained to the interior without opening the door of the cabinet.

The entire apparatus is made of solid oak, highly polished, and with a white enameled interior.

Price, $275.00.

Full shipping directions should accompany the order.

When not otherwise specified, we will ship by express to nearest destination.

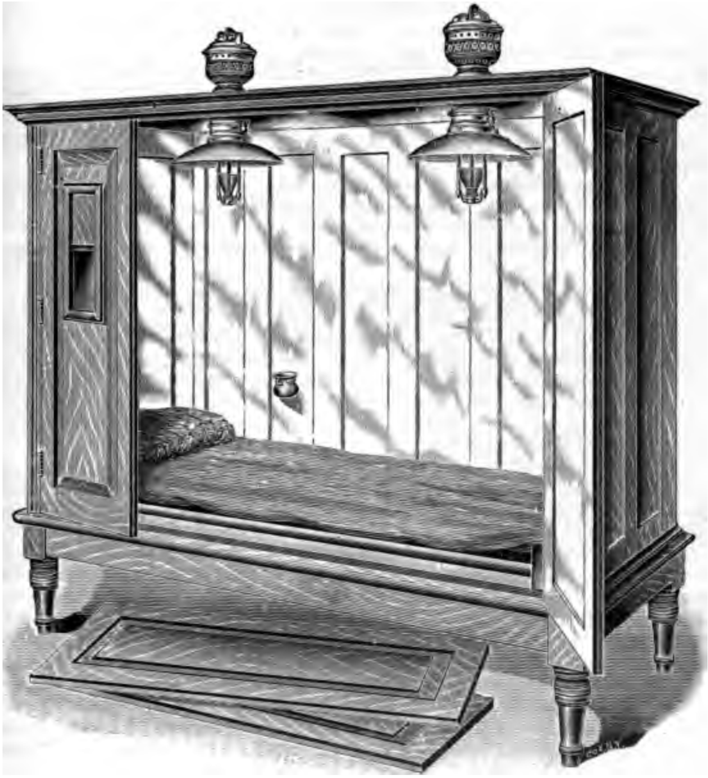

FIG. 11.
Arc Light Bath.

Appendix

On the Penetration of the Human Body by Ordinary Actinic Light

BY WILLIAM S. GOTTHEIL, M.D., AND MILTON W. FRANKLIN, M.D.

(*Medical Record, April 19th, 1902.*)

I.

IN the present state of our knowledge concerning light, the following assertions may be made:

1. That the tissues of the human body, like all other substances, are penetrable to varying degrees by the wave vibrations of light; and that these vibrations form an essential part of the stimuli that determine the life activity of the cells, with effects that may be beneficial or injurious.
2. That the light vibrations affect bacterial life, and are, in general, injurious or fatal to it.
3. That of the various components of ordinary white light, the rays in the more refrangible end of the spectrum, the blue, violet, and ultra-violet have far greater chemotaxic and actinic effect than those of the red end.
4. That these so-called actinic rays are comparatively more abundant in the electric arc than in sunlight.
5. That the action of light upon the tissues depends upon the rays absorbed, not upon those transmitted; but that when several superimposed layers are to be acted upon, the effect upon the deeper ones depends upon the actinic transparency of the superficial strata.

The two opposite properties of actinic transmission and actinic absorption, or transparency and opacity to the light waves, are possessed in varying degrees by all the tissues. The ordinary phenomena of transillumination show the perviousness of thin layers, as in the ear or cheek, to the visual rays; and Gadneff's and Soluchat's well-known experiments, in which sensitive silver salts, in sealed capillary tubes, introduced under the skin and into the tissues, and then exposed to sun and electric light, with reduction, show actinic penetration. Freund has recently made exact spectroscopic determinations, showing that chemically active, as well as visual rays, pass freely through epidermic tissues of considerable thickness.

That actinic absorption occurs in the tissues is evident from the fact that the body is opaque, both optically and chemically, to light under ordinary circumstances. In estimating the value of any special source of light for the purpose of influencing the deeper tissues of the body, it is necessary to prove the efficient penetration only of the actinic or chemical rays; for the portion reflected from the surface is small, and all the rest, save that which passes through the tissues, is absorbed and effective. The question is an important one, for on its answer depends the entire applicability of the method for treating affections of the internal organs.

For the purpose of determining it, a series of experiments were made, the results of which are here given. The source of light was an electric arc in the condensation apparatus or Actinolite operated at sixty amperes, and with condensers of an angular aperture of sixty-seven degrees. The rays were arranged nearly parallel in a pencil, being just sufficiently convergent to form a circle large enough to cover the plate employed.

Ordinary photographic plates were used as sensitometers, since they react more especially to the actinic or chemical rays of the violet end of the spectrum, which are the very ones which we desire to employ therapeutically. The subject of the experiments was a mechanic, aged twenty-three years, with good, firm tissues.

Developed negatives of average density were selected, and to the face of each the film side of a sensitive plate was applied. The edges of the plates were bound with black lantern slide strips, and the back of each set covered with thick opaque paper. By this means the plates were so protected that light could reach them only through the negative.

The prepared sets of plates were applied, with the negative next to the skin of the body of the subject in the dark room, and the whole covered with adhesive strips and black cloth so thoroughly that no light could possibly affect the plate without first passing through the body. When all was ready the subject was seated in front of the arc and the light passed through various portions of his body on to the sensitive plates.

The time employed for each exposure was determined by experiment, since there were no data available for the purpose; and even if there had been the differences in the densities and thickness of the tissues in different individuals would prevent their being of much use. Several series of similar experiments were made, to prevent error. The subjoined, with the result attained, will serve as an example:

Plate 1.—Light on the anterior surface of the forearm, plate on the back. Thickness of transillumined tissues, 8 cm. Time of exposure, ten minutes. The plate shows the image of the negative, together with the shadows of the radius and ulna.

Plate 2.—Taken through the shoulder. Light upon the anterior upper portion of the thorax, plate upon the scapula. Thickness of tissue about 16 cm. Time of exposure, twenty minutes. This plate showed a fairly even deposit, save where the great differences of density of the various parts of the scapula affect the result.

Plate 3.—Taken through the left abdominal region. Light upon the left umbilical region, plate on the left lumbar. Depth of tissue, about 19 cm. Time, thirty minutes. This plate showed a very even and perfect exposure, save where the disk of light, not quite accurately directed, failed to cover the entire plate.

Necessarily the amount of actinic light transmitted through tissues of such thickness and varying consistency is relatively small; in addition to which the red color of the blood further hinders its passage. If the contrary were the case, and the tissues were very transparent to the light, but little effect could be expected; for it is the absorbed light that is changed into other forms of energy, and is efficacious. Hence, therefore, the exposures were prolonged.

The problem before us was to ascertain if, with the most powerful means of artificial light at our disposal, the actinic vibration could be made to traverse two layers of skin, and the varying thicknesses of subcutaneous fat, muscle, bone, and organs, the whole permeated in every part with a moving red fluid, to such an extent that the portion of it passing through would affect a sensitized plate. This has been abundantly proved for thinner layers, but not, so far as we can ascertain, for the entire thickness of the body. Yet a light must be able to do this, if the organs of the interior of the body are to be influenced by it.

Conclusions. 1. Light, in proper concentration from a source of sufficient actinic power, can be made to penetrate the entire thickness of the human body, including both surfaces of the skin; hence all the internal organs are accessible to its influence.

2. Since no portion of the interior of the body, however, can be more than half the thickness of the frame from a cutaneous surface, and much of it is much closer, the time required for efficient actinic penetration to any depth is only a fraction of that employed in the experiments, and, conversely, if the time employed is equal, the chemotaxic effect will be far greater.

3. The proof of the penetration of actinic light to and through the internal organs apparently opens a field for its successful employment as a therapeutic agent in internal maladies, in view of its admitted efficacy in a number of external affections.

Actinotherapy in Cutaneous Medicine—A Preliminary Communication*

BY WILLIAM S. GOTTHEIL, M.D., OF NEW YORK.

(*The Medical News, July 6th, 1901.*)

II.

THE employment of light as a therapeutic agent is no new thing in medicine. The best term to employ for this method of treatment in general is phototherapy. The use of that especial form the discovery of which has immortalized the name of Röntgen is generally known as radiotherapy. Actinotherapy seems to be the most suitable designation for the employment of ordinary sun or arc light, or portions of their rays. It is to this latter that I desire to call attention.

To go no further back than the time of General Pleasonton, most of us recollect the "blue glass craze" that then swept over the land. Wonderful therapeutic results were attributed to its use; and isolated specimens of the blue glass panes that then appeared in so many southern windows may still be seen. But Pleasonton and his followers truly saw "as through a glass darkly"; their method was not only empirical, but was developed largely by persons who had no medical knowledge; and it never, therefore, obtained the general recognition of the profession.

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* Read before the Section on Cutaneous Medicine of the American Medical Association, St. Paul, June 8, 1901.

The bactericidal action of light is now a well-known and established fact. Cultures of many virulent and pathogenic microbes die in a short time when exposed to properly concentrated light. Axel. L. Larsen[*] has lately gone over the ground again with the pus organisms, the colon and typhoid bacilli, etc., and has endeavored to ascertain the time required to weaken and destroy them with given concentrations of light. But this is by no means its only action and probably not even its chief one. Light irritates the cutaneous nerves, and so affects the central nervous system. It increases the oxidation processes in the cells and the amount of hemoglobin in the blood. This heightened tissue metamorphosis is possibly the factor on which its future therapeutic application will be based. The ordinary phenomena of transillumination show that light penetrates the skin. Contact photographs have been made by means of light that has passed through the human body, notably by Kime, of Fort Dodge, and H. L. Mason, of New York. Glass tubes containing sensitive silver salts have been introduced under the skin of animals and have shown the characteristic effects of light penetration on removal.

To Neils R. Finsen, of Copenhagen, however, belongs the credit of developing the light treatment and placing it upon a scientific basis. Since he recorded the the good effects which he had gotten in variola from the employment of red light several years ago, he has been an indefatigable worker in this field; and to-day his Actinotherapeutic Institute in Copenhagen has a world-wide reputation and enjoys the active support of the Danish Government.

I shall leave out of account, as foreign to the object of this preliminary paper, the work that has been done in other than dermatological fields with the new treatment, or an account of the various forms of apparatus that are employed. Suffice it to say that Helm[†] Gerson,[‡] Morris,[§] and Finsen, Bie, and their collaborators have employed it in many varied dermatoses with a large proportion of good results. Besides lupus and the various dermal tuberculoses, in which it is possibly destined to be the treatment *par excellence*, it has been used in lupus erythematosus, psoriasis, epithelioma, acne vulgaris, rosacea, alopecia areata, eczema, ringworm, contagious impetigo, and various ulcerations with success.

Either sunlight or the electric arc can be employed, but the former is too uncertain in most parts of our country to be relied upon. The chemical or actinic rays of the more refrangible end of the spectrum are the elements from which therapeutic effects may be expected, and we have fortunately in the electric arc a source of light which is accessible in all our large centers at any time, and which is especially rich in them. Sunlight is cheaper, of course, but it is only in regions like California or New Mexico, where it can be relied upon for any great part of the year, that the expense of installing a sunlight apparatus would be warranted. The arc light can be employed on cloudy days, or in the evening; and this leads me to mention and dispose of one apparent disadvantage of the process. The actinotherapeutic treatment takes time; of that there can be no doubt. But I am convinced that it does not even now require the hourly sessions every day which Finsen gives his patients. Were that the case, no matter what its advantages, it would have to be relegated to institutions where the necessary elaborate arrangements for the simultaneous treatment of a number of patients could be made. Increase of the amperage employed and reflection and concentration of all the available rays upon the area to be treated have enabled me already to reduce it very materially, and I have no doubt that further progress in that direction will very shortly be made. I now give half hourly sittings every other day. The question is solely one of actinic light intensity.

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[*] Mittheilungen aus Finsens Medicinske Lysinstitut, 1900.

[†] Deutsche Medicinal-Zeitung, No. 10, 1900.

[‡] Archiv für Lichttherapie. Vol. I., No. 3.

[§] British Journal of Dermatology, August, 1900.

I employ the instrument manufactured by Kliegl Brothers, of this city and called by them the Actinolite. It consists essentially of an arc light with the necessary arrangements for automatic action, enclosed in an iron hood. In the hood in front of the arc is a double convex condenser, adjustable for focusing purposes by means of a rack and pinion. On rods that project in front from each side of the hood is a double convex focusing lens, also adjustable. By means of these condensers a circle of light of any size can be readily obtained; of course, the smaller it is the more intense is the illumination. The hood is swung in such a way that it can be raised or lowered, or swung laterally or vertically, thus making it possible to project the light spot with exactitude upon the area that is to be treated. On the front bars and between the hood and focusing lens is a cell for the purpose of containing the fluid to cut off the heat rays. This can be filled with distilled water of methylene blue or alum solution; or it may be connected with the two water-bags for which arrangement is made, so that a continuous stream of heat-absorbing fluid may flow through the cell. So far I have found plain cold water without continuous flow quite sufficient to prevent any unpleasant heat effects from the concentrated light. The base of the instrument contains a suitable rheostat, with a selector on top. Either the continuous or the alternating current may be employed and from 25 to 55 amperes of current can be used. The candle-power obtained varies, of course, with the amperage. With a concentrated circle of light it runs from 20,000 to 60,000.

I am not prepared as yet to make a definite statement of the results obtained with the treatment save in two cases. In one patient with extensive lupus vulgaris they promise to be brilliant. The only area that has been treated, some two inches square, presents a marked contrast to the other locations where the disease is progressing. It is almost white, only two or three lupoid nodules remain, and they are disappearing. And this has been accomplished without ulceration or even inflammation; the process has been entirely one of interstitial absorption. All the other areas are characteristically infiltrated and scaling. The patient has had absolutely no other treatment.

The second case is one of obstinate tertiary syphilitic ulceration of the leg. The light has apparently had a very good effect in stimulating the indolent glazed ulcer, so that it is now nearly healed, after resisting other internal and local treatment for weeks.

Now as to the advantages of the method. First and foremost it is eminently conservative. It causes no radiodermatitis, ulceration, or loss of hair, such as too often, though sometimes necessarily, occur under the Röntgen treatment. I do not know of the record of any serious trouble from its employment. Finsen rightly lays stress upon this point; and to dermatologists it is of special importance, since many of the affections that they are called upon to treat occur upon the face. In the second place it is entirely painless. This is a great desideratum, more especially in dealing with women and children. Third, it is effective. New as the method is, there is already concurrent testimony from a sufficient number of competent observers to demonstrate that we possess a powerful therapeutic agent in concentrated light.

Leaving to others the study of the effects of actinotherapy in the general conditions and affections of the internal organs in which it may prove useful, it is to be presumed that by dermatologists it may be employed in the various skin affections which are dependent upon micro-organic or parasitic infection, or where increased tissue metamorphosis is a desideratum. Lupus vulgaris, lupus erythematosus, mycotic eczema, trichophytosis, favus,. impetigo, furunculosis, tuberculosis cutis, epithelioma, mycosis fungoides, blastomycosis, actinomycosis, and similar affections are the diseases in which it is likely to prove useful.—*Medical News*, July 6, 1901.

144 West Forty-eighth Street, New York City.

Electric Light in Diseases of the Respiratory Organs*

BY W. FREUDENTHAL, M.D., NEW YORK.

(*The New York Medical Journal, July 12, 1902.*)

III.

THE study of the wonderful physical and chemical effects of certain rays of light has led to a number of remarkable inventions, some of which have been known to us only a very few years. No wonder that this has brought nearer to the mind of the investigator the idea of applying these rays as remedies for pathological conditions of the human system. The ease with which the application of these rays is acquired has, alas! brought the whole matter too quickly into the hands of unscrupulous physicians and quacks and—into discredit. Instead of quietly awaiting the results that could be reasonably expected of this method, it has been lauded to the skies by newspapers all over Germany, and now the yellow press of our metropolis has taken hold of it in the same harmful manner.

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*Read before the eighth annual meeting of the American Laryngological, Rhinological and Otological Society, held at Washington, D. C., June 2, 3 and 4. 1902.

In spite of all, this new branch of our science is destined to gain a permanent place in our therapy. Already there has been established a chair for this branch of medicine at the University of Berlin, the incumbent of which is Professor Lesser. In Copenhagen it was Finsen who received very deservedly the assistance of his government, and in most other capitals of Europe light is being investigated and experimented with in a scientific manner. I, therefore, consider it a great privilege to discuss this topic before this learned society to-day. Let us consider first—

The Physiological Effects of Electric Light.—In a previous paper I discussed the physical and chemical effects of light on the animal system, and in this connection I drew attention to the experiments made by Bergel. This author had studied the effect of light and darkness upon the movement of the ciliated corpuscles, proceeding in the following manner: He put the microscope into a dark cabinet, which was placed upon the observation table. The cabinet was perfectly closed, with the exception of two openings. The one, when illuminated, was for the observer, but could be darkened by means of curtains when it was desired to shut the light off. Just opposite the microscope was another opening, which could be exposed to direct sunlight or closed, as desired. Now, if a ciliated corpuscle in motion was placed under the microscope, and the latter darkened, it could be seen on inspection after a while that the motion of the corpuscle grew slower and slower, and finally ceased. The more rapid the vibration before the withdrawal of light the longer the period of activity of the corpuscle in the darkness until it became motionless, and, *vice versa*, the slower and weaker the vibration of the cilia, the shorter the time up to the cessation of all motion.

When a corpuscle that had been kept in the dark, showing no motion whatever, was exposed to bright daylight again, the oscillation recommenced after a latent period, depending upon the duration of the exposure to darkness. The longer the corpuscle remained in the dark after it had become motionless the longer it continued in a quiescent state until the resumption of oscillation. This could be repeated several times, but soon a sort of fatigue was noticed in the corpuscle. This showed itself also when the corpuscle was kept too long in the dark.

Do not let us forget these facts, as they will help us to understand the effect which light exerts on some diseases of the upper and lower respiratory tract. But light produces more than this. It exerts directly and indirectly a great influence on the metabolism of the whole system when applied to the skin, and in that way it can be advantageously utilized in some constitutional diseases. In the beginning of my experiments with the arc light it was the prevailing view that all rays of light penetrated into the deeper tissues. I hoped in that way, for example, to be able to attack tuberculosis of the lungs, thus destroying perhaps directly the tubercle bacilli by the violet and ultra-violet rays, which, as you know, have the most marked bactericidal power. Now, in applying phototherapy the skin is very nicely transilluminated, but the ultra-violet rays barely penetrate the epidermis, and even when applied in concentrated form do not pass deeper, according to Strebel.* The blue and violet rays, which are also bactericidal, are absorbed in the first thick layers of the bloodvessels of the thoracic wall, while red and ultra-red permeate the cutis and pass into the deeper tissues. Those structures which are relatively diaphanous for certain rays allow them to pass through even thick layers, as, for example, the mass of muscles of the chest. According to Strebel,† of Munich, the penetration of these rays must be necessarily accompanied by a modification in the motion of the waves—a temporary arrest. Light is converted into heat waves, and perhaps even into long electrical waves. The trans-illuminated skin becomes translucent and appears of a brilliant red, and is therefore in a different state than ordinarily. That such a permeation of light cannot be without influence upon the molecular state of the tissues and their functions is easily understood. Direct action upon the chemical processes and stimulation of the functions of the tissues and protoplasm in a reflex manner are the consequences of the exposure to light.

How we may utilize these facts for our purposes we shall see later on in the therapeutic part of this paper.

By direct experiments the effect of the ultra-violet rays had also been determined. After it had become known that cultures of tubercle bacilli were destroyed by the sunlight (R. Koch), it was found that the arc light contained more ultra-violet, *i. e.*, bactericidal, rays than even the sun, and was therefore tested with equal or even better results. We then learned through the experiments of Geisler, Deudonné, and Buchner that the growth of the bacillus of typhoid fever was hindered by light, and Kitasato proved that the bacillus of bubonic plague was killed within three or four hours after exposure to light. After all this and more regarding other infectious germs had been demonstrated, Esmarch tested the disinfecting power of the sunlight by exposing to its direct rays different household materials, such as bed coverings, pillows, etc., all of which had been infected with pure cultures of bacteria. The result was that in the superficial layers the bacteria were destroyed after a few hours, while those deeper down were very little or not at all affected, even when subjected to the sunlight for a number of days. Practically the same results have been obtained when electric light has been applied as a bactericidal agent to the deeper parts of the organism, *i. e.*, nil. But the electric light has other properties to which I will now refer, and which are of the greatest value to us. First, its effect on the skin. The skin is an exceedingly important organ in metabolism, and its functions are neglected more than those of any other organ I know of. It supplements the functions of the kidneys and lungs and is most important in eliminating poisonous products of metabolism through its glands. Now, if arc light or sunlight is applied to the skin, its metabolism will be increased immensely, and indirectly at the same time that of the deeper organs as well. We have to consider, therefore, light as a powerful stimulant and regulator of general nutrition. Electric light has furthermore a very marked *anesthetic* effect on the skin and those "inner" parts which can be reached by it. Dr. A. V. Minin found that blue light produced an anemia of the parts exposed, and that he was "able to dispense with cocaine when suturing wounds, incising abscesses, and for smaller operations." I have not tried it in such cases, but have found that pain between the shoulder blades, etc., in consumptives, was occasionally and sometimes very promptly relieved by the arc light. Pain in the larynx has also been relieved, as we shall see later on. We come now to the

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* Penetration of all the tissues by actinic light is proved by Gottheil & Franklin's experiments. See p. 28.

† Die bisherigen Leistungen der Lichttherapie. *Berliner Klinik*, February, 1902.

Therapeutic Action of the Electric Light.—In speaking of the action of the electric rays of light we have to distinguish between the incandescent lamp and the arc light. While the incandescent lamp is nowadays used principally for its sudoriferous effect, the arc light is applied for the reasons set forth above. Dr. J. H. Kellogg, of Battle Creek, Mich., was the first to construct and employ an apparatus for applying incandescent light to the whole body. The difficulties encountered in using the sun bath led him to the study of the electric light as a substitute for sunlight. In 1894 he presented* a description of a new method of applying heat to the body in which the incandescent electric light was utilized as a source of heat. Afterward the study of this was taken up by Willibald Gebhardt, of Berlin, E. Below, Kattenbracker, Strebel, Winternitz, of Vienna, and others. I commenced its study perhaps earlier than any of these gentlemen, without, however, formulating a definite method. Although I felt that we had in the electric light a powerful agent, I could not exactly say in what manner it worked. As early as 1889 I applied incandescent light to the larynx. How I came to use it and the other particulars you will find in my paper on Electric Light, etc.† Since 1889 electric light has been almost uninterruptedly one of my favorite applications in tuberculous laryngitis. The effect has usually been soothing and the patients have liked it very much. Of late, however, I have become convinced that the arc light is preferable even for the larynx.

There are various apparatuses in the market, which are supposed to serve the same purpose. At the Montefiore Home I have used the so-called ACTINOLITE, but in my office an ordinary search light, the same as is used on board ships, is employed. This has been modified now and is called electro arc chromolume, but I prefer the old style. As in my practice cases of lupus are very rare, I have not applied Finsen's apparatus, which is not only very expensive, but theoretically wrong.‡ Finsen has but one source of light (*i. e.*, one arc light), with which he treats four patients at the same time. Each patient would therefore at best receive only one-fourth of one arc light if it were not that a certain amount of rays was lost in the interspaces between the tubes. Thus the amount of light for each patient is surely not more than he would receive from an ordinary search light with much less amperage. By these remarks I do not seek to detract one iota from the credit which Professor Finsen so justly deserves, but I write this for scientific purposes and not for flattery. To overcome the great heat produced by the electric light, various devices have been published: lenses, glass screens, running water, etc. The trouble is that they all absorb a certain amount of rays which we cannot afford to lose. We need them all. Even the red rays, which penetrate deepest into the tissues, have some bactericidal power. A glass screen is a very simple matter, but unfortunately glass absorbs particularly the ultra-violet rays. I have found it best to keep on hand pieces of linen on ice, with which the exposed parts are quickly washed as soon as they become hot. Besides, I let the patient turn around slowly in his chair and successively expose the different parts of the chest or larynx to the light. In that way my patients have the benefit of *all* the rays of the arc light, which I consider most advantageous, and they can stand the exposure easily for thirty minutes or longer. Still, for some patients I use the blue glass screen at the beginning of my treatment.

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* Kellogg's *Rational Hydrotheraphy*. Philadelphia, 1901, p. 175.

† *Med. Record*, Oct. 27, 1900.

‡ These errors are obviated in the newer apparatus.

Let us now discuss some of the diseases treated in this way and the results obtained.

1. *Tuberculosis.*—As my first experience with the electric light treatment was in tuberculosis of the larynx, I shall take this up first. The most important symptom which we are called upon to relieve in these cases is dysphagia. You know very well that there are at our disposal a number of remedies with which to combat it. And I will say here that I am to-day just as enthusiastic about the menthol-orthoform emulsion as I was a few years ago. Still, there are ulcerative processes which we cannot reach by any of the customary means. Thus, for example, in a recent post-mortem at the Montefiore Home, I observed extensive ulcerations on the laryngeal side of the epiglottis. On account of the occurrence of laryngeal stenosis, the man had been tracheotomized, and when I examined him afterward the epiglottis covered almost the entire entrance of the larynx. It was perfectly flat, so that its laryngeal side could not be seen at all. The patient had tuberculosis of both apices, though not far advanced, and suffered from excruciating pains in the larynx which no drug could relieve. A removal of the entire epiglottis might perhaps have relieved him, but he refused all further operations. As a last resort I tried electric light, and that was the only thing that relieved him *somewhat.* He at least could take some food. Very soon, however, he became too weak to be taken to the room for treatment and died of inanition.

Another case is that of M. S., the history of which I published in part in the *Journal of Tuberculosis.** I gave at the time the following interesting history:

"M. S., twenty-three years of age, newsdealer. He became sick a year and a half ago, when he commenced to cough and had 'trouble with the throat.' He went to a clinic, where he was operated on. Nothing further could be elicited from him. On examination, I found a tumor-like infiltration on the right ventricular band. He had dyspnea, which he attributed to the condition of his lungs. I removed the infiltrated parts and he immediately told me that he could breathe more freely. Although the patient was in an advanced stage of pulmonary tuberculosis, he stood the curettage very easily. In fact, he hardly felt that I was operating on him. There was no loss of blood to speak of, no rise in his temperature and he felt as comfortable as could be expected. Two weeks later, however, he had a hemorrhage and fever up to 102.5°. When I examined him again, six days later, at which time he had recovered, I found that there was a recurrence of the infiltration. At the end of another week this had reached the same dimensions as before. I operated again, and now, *i. e.*, three weeks later, the patient feels well, and so far there is no visible recurrence. How long this will last is naturally uncertain. Although the hemorrhage occurring after the first curetting might have been a mere coincidence, still there is a possibility that a new active process had started within the lungs right after my surgical intervention. I have observed another case where the same thing happened, hemorrhage, high fever, etc. We ought to keep this in mind before resorting to operations. But this is only apropos."

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* Operative Intervention in Laryngeal Tuberculosis.—*Journal of Tuberculosis*, April, 1902.

I made the above remarks on February 3, and to-day, May 15, both sides of the larynx again show large infiltrations. Early in March he was seized with pain in the throat, owing most likely to ulcerations below the glottis. Not being able to relieve him otherwise, I began the use of the electric light in the following manner:

March 4th,	exposure to throat	10	minutes.	Feels slightly easier while under treatment
March 7th,	"	10	"	"
March 8th,	"	12	"	"
March 9th,	"	15	"	"
March 11th,	"	20	"	Had marked pain yesterday, but feels much relieved during and after exposure
March 12th,	"	25	"	"
March 14th,	"	30	"	"

From the 15th on he was exposed regularly five times a week, and he feels much easier. I shall continue with that treatment and watch further developments. There is no influence of the electric light treatment visible on the infiltrations in the larynx. These two cases, therefore, show some results from the electric light treatment which are due solely to this and to nothing else.

But, gentlemen, it is impossible to speak of tuberculosis of the larynx without referring to that of the lungs. Although we are assembled here as laryngologists, we cannot in cases of general systemic diseases limit ourselves to the larynx alone. In tuberculosis of the latter we have to treat the lungs as well, just as we have to treat the general syphilis when we have a case of specific affection of the nose or the throat. I therefore subjected the lungs of these patients as well as the larynx to the electric light, and here we have to ask ourselves again, What can we expect from the electric light in tuberculosis of the lungs? Let me say at the start that I have applied this method for over three years, but I do not believe I have cured one single case of advanced tuberculosis by it alone. Still, shall we throw it aside as useless? Surely not. You have not cured one case of tuberculosis by morphine or heroin or hydrotherapy alone, and nevertheless you employ them constantly, often to great advantage. The electric light has come to stay, and it will stay in the treatment of tuberculosis as an auxiliary to other measures. When we consider that the thorax is transilluminated over its entire extent, it will be evident that the skin of this region will be stimulated to renewed activity, and that this will be followed by an increase of the general metabolism. In other words, it will augment nutrition by promoting the appetite, by relief of sleeplessness, nervous irritability, etc. Says Strebel: "The good influence of electric light on the strength and nutrition of the tuberculous, if not too much reduced and debilitated, seems, according to my experience, incontestable." This has been the writer's experience as well. In this particular respect electric light stands on the same level as hydrotherapy. Kellogg, in his excellent text-book on *Hydrotherapy*, was the first one to grasp this idea and to discuss both questions. They belong together. Now, it will depend upon the individuality of the patient, upon his strength, and upon the mode of infection (mixed or not), whether in one case we apply a wet pack or douche and in the other case electric light or even sunlight. What is good for one may be poison for the next. In several cases I have noticed that electric light reduced the high temperature for a few hours, just as a sponge bath or a full bath would have done. But I am not prepared to attribute this to the electric light alone. Perhaps we could obtain the same effect by exposing a patient naked or half-naked to the surrounding atmosphere. If, in all these respects, electric light stands on the same level with hydrotherapy, there are two points in which it is far superior, viz.: 1. It removes the pain more promptly. 2. It facilitates expectoration. I have spoken of the first point above, and will only say here that pains in any part of the chest and larynx, from different causes, were relieved very promptly by electric light. Naturally, as long as the original disease was not removed, they returned. As to the second point, I have to remind you, once more, of the experiments by Bergel. When he exposed a ciliated corpuscle that had been in the dark and inactive to bright daylight, it commenced to oscillate again. In our cases the ciliated corpuscles are inactive because the bronchi are filled with a mass of secretion, etc.

It requires an extraordinary stimulus to make these corpuscles move again. This stimulus is brought about by the arc light, which penetrates into the deepest bronchioli, thus exercising a direct influence upon the ciliated epithelia. Under this influence they resume their work. In other words, they again oscillate and carry the secretions to the upper parts, from which they can be expectorated easily. The patients will tell you that they now are capable of bringing up one or more "big lumps," and consequently feel relieved for a time. I remember one patient who was driven to my office daily up to two days before her death in spite of high fever, etc., as she always felt so much easier after exposure to the electric light. She could expectorate better and had less pain and less fever. In incipient cases you may bring about a cure by these means. I believe that some of my cases have been cured in that way, but in advanced tuberculosis electric light *is only a palliative measure of occasionally great value.* This difference was clearly shown between my private patients and those of the Montefiore Home. In my private practice

I mostly treated early cases, while at the Montefiore Home the majority were far advanced and bedridden. The results varied accordingly. Allow me to give you a few histories:

CASE I.—A. R., twenty-four years of age, a drummer, came to me September 6, 1900. He had been well up to a week before, when he caught a severe cold. Since that time he had had intense pain in the throat, more so at night; could not swallow food, although he was hungry. He admitted he might have had a slight rheumatic attack before. The examination showed an acute amygdalitis sinstra and ulceration in the left fossa glosso epiglottica, both of which I attributed to rheumatism. In a few days the ulcer disappeared under salicylate of sodium and local astringents, and so did to some degree the pain. But very soon he felt it again, "farther up." The left tonsil was more swollen and sensitive to the touch.

September 10.—Tonsil more swollen, no abscess; edema of the uvula and neighboring parts on the left side. Severe pain. I applied electric light for forty-five minutes to the left side of the throat, with the result that, for the first time in two weeks, the patient slept well.

September 11.—Edema has disappeared, the tonsil is much less swollen and much less sensitive, and he feels comfortable.

September 20.—Says he does not regain his strength. Has some pain over the chest. On examination, I found some râles over the left clavicle anteriorily, bronchial expiration and tubercle bacilli in the sputum. I treated him daily with electric light for about five weeks, when all the symptoms had disappeared. He went back to business and has been in good health since.

In this case the effect of the electric light application to the tonsil and uvula was simply remarkable, and the patient did not know how to thank me enough for it. These primary conditions, however, were, as I believed, of a rheumatic nature, although the pain was very great. When, later on, tuberculosis had developed, we could not effect the cure "overnight," as in the beginning, but the result, nevertheless, was extremely gratifying.

CASE II.—Miss M., seventeen years old, was sent to me from Pennsylvania. She had been hoarse for a year, coughed occasionally, had night sweats, no appetite, and often felt dizzy. She was very anemic, which showed itself especially in the pharynx and epiglottis, while the other parts of the larynx were rather congested and partly thickened (infiltrations?). The lungs showed dulness over both clavicles, more marked on the left side, slight râles anteriorily and posteriorily, and bronchial breathing over the left clavicle. Besides, there were hypertrophies in the nose, which were removed. The sputum could not be examined, as she raised none, but there was no doubt that we had to deal here with a case of tuberculosis. She remained in this city from April 25 to July 5, 1900, after which time she went to the mountains. The symptoms gradually disappeared, there were no râles, breathing was vesicular, there was no rise of temperature or night sweats when she was discharged. The larynx was still congested, and her appetite had not improved so much as we had hoped for. I hear, though, that she has been well since. In this case of incipient phthisis a "cure" was also effected, so far as we can speak of a cure in such cases and this was mostly due to electric light.

Of great interest is the following case:

Case III.—Mrs. Z., aged thirty-four, consulted me first on January 25, 1901. She had had pleurisy twelve years before, from which she recovered entirely. Two years before another attack of pleurisy came on, and since then she had been ill. A year before she became hoarse, but improved after a stay at Liberty, N. Y. Eight months later, while still at Liberty, she became hoarse again and remained so. Her throat felt "raw." She had pain and dysphagia, profuse night sweats, and rise of temperature for the preceding ten days (in the morning, 100° F.; at 1 P. M., 103°; and at 8 P. M., 102°). No signs of lues. On examination, I found glandular swellings of the neck, more pronounced on the right side. The right vocal cord was ulcerated, and on the left arytenoid there was an infiltration which had the appearance of a polypus.

Lungs.—Dulness over the left side almost to the heart, and coarse râles and bronchial breathing. Right anteriorily, dulness over the apex, bronchial breathing, and coarse râles. Left posteriorily, dulness down to the bifurcation, less markedly on the right side. I injected the menthol-orthoform emulsion, and exposed her to the electric light. She soon felt easier in the throat, although her whole condition was getting worse. I noticed, however, a remarkable change in her temperature; for several hours after exposure to the electric light it went down two degrees or more. While she formerly had had her highest temperature at 1 P. M., it was now almost normal at that hour.

It ranged in the following way:

February 4, temp., 8 A. M., 101°—exposure to electric light at 11 A. M.; temp., 1 P. M., 101°; temp., 8 P. M., 103.6°.

February 5, temp., 8 A. M., 101°—exposure to electric light at 11 A. M. temp., 1 P. M., 100°! temp., 8 P. M., 103°.

February 6, temp., 8 A. M., 102°—exposure to electric light at 11.30 A. M.; temp., 1 P. M., 100°; temp., 8 P. M., 103°.

(About the same conditions up to the 9th.)

February 10, temp., 8 A. M., 102°—exposure to electric light at 10.45 A. M.; temp., 1 P. M., 99.4°; temp., 8 P. M., 102°.

February 11, temp., 8 A. M., 100°—exposure to electric light at 11 A. M.; temp., 1 P. M., 98°; temp., 8 P. M., 102°.

February 12, temp., 8 A. M., 101°—exposure to electric light at 11 A. M.; temp., 1 P. M., 99°; temp., 8 P. M., 102°.

February 13, temp., 8 A. M., 101°—exposure to electric light at 11 A. M.; temp., 1 P. M., 100°; temp., 8 P. M., 103°.

She remained about the same for three weeks, after which she sank rapidly. Her morning temperature ranged between 102° and 103° F. In spite of this she was driven almost daily to my office, although it was extremely difficult for her to get out of bed. But she persisted in coming, as she always felt so much easier for hours afterward. She visited me up to the 14th of March, when she was no longer able to leave her bed, and two days later exitus letalis occurred.

The following case is also interesting from various points of view:

Case IV.—I. B., nineteen years old, had not done any work for the preceding three years, during which time he had resided in Denver. A few days before, he returned from that place, on account of "terrible" pain in his throat. For two months he had not been able to eat well, and for a week he had hardly been able to eat anything at all. He could not swallow even a drop of *cold* water. Examination showed advanced tuberculosis of the lungs, a small cavity in the left lung, a large ulcer of the left tonsil and left arytenoepiglottic fold. I applied menthol-orthoform emulsion, but he did not feel easier the next morning, November 15, 1900. On that day I applied the same emulsion to the larynx and afterward the orthoform alone to the tonsil. But I used the precaution to let him bend over his head to the left, so that the orthoform could remain on the tonsil. The result was such as I had seen frequently before. He could eat and drink for four hours and a half afterward. The next day I commenced with electric light treatment. Although I treated him almost daily from November 16, 1900, to January 3, 1901, the electric light had absolutely no effect in cicatrizing the ulcers or diminishing the dysphagia. In spite of the most careful treatment the ulcers grew larger, a new one developed on the same side in the retropharynx and another one on the right tonsil. Orthoform always removed the dysphagia, and when I left it off he could not swallow. Still, although he was well aware of that fact, he asked always for the electric light, as he felt very much easier in the chest after its application. And this patient, too, came to my office in spite of high temperature (102° and 103°) until four days before he died.

I have a long list of patients treated by me in the same way for tuberculosis of the throat and lungs. While by far the majority liked the treatment and asked for it, I can see in the electric light only an *adjuvant to the host of other remedies at our disposal, an adjuvant that is of great assistance to us in the management of some cases of tuberculosis.*

Hay Asthma.—As in these cases the neurotic element is almost invariably an important factor, the effect of the electric light treatment has been much more conspicuous. I have had patients come into my office with râles all over the chest, constant sneezing, etc., who left one-half hour later with no râles to be heard and a slight coryza only. A colleague of this city has told me that he has achieved the same results with the high tension current. I can understand that, since the rays from both sources are said to have very similar effects. Nevertheless, one of my patients came to me directly after he had been treated by another physician with static electricity in vain, and I was able to afford him the most marked relief immediately. Perhaps there is a good deal of suggestion in that treatment; but it makes no difference how we cure our patients, if we only cure them.

I generally apply electric light to the face indirectly, by letting the rays pass through a blue screen. The heat of the electric light in summer would be too intense to bear for any length of time on the face. I pursue the same plan on the chest if there is a necessity of applying it here. During the last two years I have treated twenty-four patients with hay fever. Out of these, fourteen experienced decided improvement in all respects very soon after the treatment was commenced. In some cases the profuse discharge from the nose, sneezing, and asthma were relieved right after the first exposure to light. All these fourteen patients could stay in the city and attend to their business, but of course had to come for treatment regularly. Six out of these fourteen were treated during two seasons, and it seemed as if all had much weaker attacks the second time than in the previous year. The rest of the patients, ten, improved but little or left treatment too soon to form an opinion.

The following will serve as an illustration:

Mr. C. K., aged thirty-five, manufacturer, came to me first on September 9, 1900. A year before he was attacked for the first time by hay fever, and this year it commenced as early as August 6, at noon (!). He had all the symptoms of this disease in a very aggravated form; sneezing, running of the nose and eyes, asthma, insomnia, loss of appetite, etc. I applied suprarenal extract to his nose and exposed him to the light, when he professed to feel like a new man. Besides, I gave him hydrochloric acid to take internally, and in two days he went to business again. I saw him every two or three days until the beginning of October, when he had no further trouble.

The good result in this case was so much the more remarkable, as this patient had been subjected to all sorts of treatment. He even saw a very prominent consulting internist in this city, who told him nothing could be done for hay fever patients! The following year I began treating him on July 16, in order, if possible, to avoid a recurrence. We succeeded to a certain degree, as the symptoms were much less marked. Only from the 4th to the 7th of September he felt quite heavy. At other times he occasionally had slight sneezing and rattling in his chest, which reminded him that he was not as yet out of it entirely.

May this one case suffice for a series of others which showed similar, although not always such distinct results. After the foregoing, I consider myself justified in declaring the electric light treatment a most important factor in combating the symptoms of hay fever. Whether this is due merely or mostly to suggestion, I cannot say, but the symptoms of hay fever are so unpleasant and so annoying that we must try any remedy at our disposal to relieve them.

Gentlemen, in conclusion, allow me to say that it has taken sometimes all my courage to keep up these investigations, as electric light has been brought into such great discredit. Whether all my observations and experiments, after all, will stand the test of time, I cannot foretell. Be this as it may, the fact remains that the study of light has already brought forth and will in future bring forth more beneficial effects, not only in the treatment of disease, but also in its prevention.

Some Considerations on Actinotherapy

BY WILLIAM S. GOTTHEIL, M.D., AND MILTON W. FRANKLIN, M.D.,
NEW YORK CITY.

(*The American Therapist, June, 1902.*)

IV.

THE generally accepted radiation theory of light is based upon the supposition that the all-pervading ether can be set in motion by the vibration of molecules of ordinary matter, and that this motion obeys the ordinary laws of wave motion. Thus energy is conveyed in waves from one body to another; and this process of energy transference is what we call radiation.

The ether waves are best likened graphically to the motion that is imparted to a rope which is fixed at one end while the other is moved in a plane at right angles to that of the cord. The ether oscillations are at right angles to the direction in which the wave is moving and parallel to its front. Those waves produced by vibrations of molecules of a frequency ranging between 20,000,000,000,000 and 40,000,000,000,000 oscillations per second have a range, to use a musical analogy, of about eleven octaves. Of these less than one octave, those between 392,000,000,000 (red end of the spectrum) and 757,000,000,000 (violet end of the spectrum) oscillations per second produce a sensation of light upon the retina. In other words, the examination of the solar spectrum by eyesight shows us a band of color running from the red to the violet which represents only about one-eleventh part of the entire spectrum as we now know it to exist. Ten-elevenths of the spectrum is invisible, and is examinable and demonstrable only by other methods; and these invisible areas are known as the infra-red and the ultra-violet regions. Only a small portion of the invisible spectrum, about 3 octaves, is situated in the infra-red; while by far the greater part, over 7 octaves, is seated in the ultra-violet.

Now, since all these waves traverse the ether at the same rate of about 186,680 miles per second, and since they have different frequencies, they must have different lengths; and these wave lengths are readily found by dividing the rate of progression by their frequency.

Ether waves falling upon bodies produce effects that vary with the length of the wave and the nature of the body impinged upon. Certain wave lengths falling upon opaque bodies produce an effect recognizable as warmth, and we then speak of the rays as a beam of radiant heat. The same or other rays falling upon the eye might produce a light sensation, and are then designated as a light beam. Or again, falling upon a sensitive photographic plate or the chlorophyl containing tissues of a green leaf, they might produce a chemical change, and be properly spoken of as a beam of actinic or chemical rays. Thus the energy produced by the ether waves may be converted into heat, light, or chemical action.

All ether waves are appreciable in these varying ways, but to different degrees, as has been said, in accordance with their wave lengths and the nature of the body acted upon. They all produce heat, into which their energy is transformed when they fall upon and are absorbed and extinguished by an opaque body. Waves of a less frequency than 392,000,000,000 oscillations per second are too slow to produce a sensation of light upon the retina, or to effect much in the way of chemical change. They are recognizable only after their impact on and absorption by other bodies and the conversion of their radiant energy into heat; they are therefore called dark heat rays.

On the other hand, waves of such high frequency as to be invisible to the eye, when they fall upon certain chemical substances, so amplify the free vibration of their molecules that the repeated rhythmic blows shatter this latter into its component atoms. These are the rays called chemical or ultra-violet.

It is with these chemical rays of the ultra-violet end of the spectrum that we are especially concerned in actinotherapy. Their power of producing chemical change is the force that we are endeavoring to employ; and this depends chiefly upon the frequency, and to a less degree upon the intensity, of the incident rays. For rays of a given length but of different intensities, the chemical change is proportionate to the product of the intensity by the length of exposure.

We have a wide range of choice in selecting the source of radiant energy to employ, and the actinic quality of the ray is the determining factor in our decision. The electric arc has been found to possess a light far richer proportionately in actinic rays than the sunlight itself, and in the form of the larger actinolytes makes a convenient and efficient apparatus. Chemical modifications of the carbons will, we think, enable us to produce arcs which are far more active in actinic energy than the ordinary carbon ones, and experiments in that direction are now under progress. But even with the carbon electrodes, the great preponderance of chemical over heat and light rays forms a theoretical justification of the treatment whose therapeutic value Finsen has so brilliantly demonstrated.

Comparatively little has yet appeared with regard to the therapeutic applications of actinotherapy. This is due to two things. In the first place it was introduced into practice in Europe for the treatment of lupus vulgaris, which is there a common and very disfiguring and recalcitrant malady. In America lupus has been a comparatively rare disease; a few cases only being the average of a year's experience in an ordinary clinic. In recent times, however, since the immigration from Russia, Italy, and other countries where the disease prevails has become large, we see more cases, especially in those districts of our seaport cities where these people mostly settle. Nevertheless the difference is well shown by comparing McCall Anderson's statement, that it is a common affection in Scotland, with the statistics of the American Dermatological Association, which places its frequency at 0.433.

The other cause is the expensive nature of the apparatus required and the cost of the treatment itself. Comparatively few practitioners are able to make the necessary installation; and comparatively few patients are willing to pay for the course. This is a defect that we hope soon to see remedied. It seems possible to make an apparatus for actinotherapeutic skin work that shall be both simple and effective; that shall be comparatively inexpensive in itself; and that, running on a low amperage, shall not require the heavy wiring or the use of the large amount of current that is the case with those at present at our disposal.

The impossibility of employing the method in institution work has so far prevented our using it on any large scale; the number of cases is still few. We have suggested its employment in tubercular affections of the internal organs, based on the one hand upon its positive effects in tubercular disease of the skin and on the other, on the proofs of the penetration of the concentrated actinic light into the inmost recesses of the body, which we presented in the *Medical Record* of April 19 of this year. Therapeutic employment in this field, however, we must leave to the clinicians of internal medicine.

In lupus vulgaris the actinic treatment occupies a definite and assured position. It has been employed in Europe for a number of years quite sufficiently to enable observers to determine the results that have been attained. Large numbers of cases have been permanently cured, and that in a most conservative manner. A minimum of disfigurement with excellent therapeutic effects can be confidently claimed for it. The same holds true of scrofuloderma, tubercular ulceration of the skin, and lichen scrofulosorum. Our own experience in lupus has been limited, but satisfactory. The infiltrations melted away by interstitial absorption. With the large apparatus at our disposal now, however, it has been necessary to cut down both the time of exposure and the frequency of the sessions, to avoid the superficial vesiculation that otherwise occurred.

The deeper seated sycoses, more especially of the beard, where there is pus infection conjointly with that with the ringworm parasite, would seem to be especially suited to the treatment. We have treated two cases, one of which was cured after three sessions, and the other was much improved when he stopped treatment after seven sittings. We should strongly recommend its employment in obstinate ringworm of all varieties.

We have not had occasion to treat lupus erythematosus by the method, but Dr. R. F. Williams, of Richmond, Va., and several European observers, have obtained positive results.

We have treated one case of sarcoma of considerable extent, in which some of the nodules disappeared by a process that could almost be called necrotic under influence of the light. The case is still under treatment, the extent of the disease rendering it necessary to apply the light to one part of the affected tissue at a time only.

Several cases of eczema of the mycotic variety, some pustular acnes, and one ulcerating gumma were treated with very satisfactory results.

At the present time we have several cases of localized pruritus, lupus, dermatitis, etc., under the actinic treatment, concerning which we are not as yet prepared to report.

Some time ago we expressed the belief that improvements in the apparatus would enable us to shorten the time of application and the frequency of the treatment very materially. This has certainly been effected. Finsen gives daily sessions of an hour. We have latterly found that sessions of ten to fifteen minutes thrice or even twice weekly were quite sufficient. Longer exposures at more frequent intervals cause the excessive local reaction adverted to above. In this connection, however, mention may be made, and especial stress laid upon the fact, that the deep and recalcitrant ulcerations, and the scleroses that have been so frequently reported from the use of Röntgen rays, have never occurred in actinotherapeutic treatment. This is not only our own experience, but is also that of the European investigators who have used the method for a number of years.—*American Therapist*, June, 1902.

On the Practical Results of Actinotherapy

BY WILLIAM S. GOTTHEIL, M.D., NEW YORK.

Physician to the City Hospital, Dermatologist to the Lebanon and Beth Israel Hospitals, etc., New York.

(*The Philadelphia Medical Journal.*)

V.

Actinic or chemical light has now been employed as a remedial agent for a number of years by various investigators, and with results that upon the whole, and in suitable cases, have been eminently satisfactory. That there are differences of opinion as regards methods and discrepancies as regards attainments is not surprising, and is rather hopeful than otherwise for the future of the therapuetic method. The excessive enthusiasm that greets a marvelous cureall is but too liable to be followed by a depression that leads to the neglect of valuable therapeutic agents. Actinotherapeusis has been in the evolutionary stage; and it has only lately become possible to say much that is authoritative concerning the value of its remedial action, the indications for and limitations of its use, and the best methods of its application.

The literature of the subject is now indeed fairly extensive; but unfortunately it is of such a character as to be hardly available for general employment. Leaving out of consideration a number of publications upon technique, instrumentation, etc., and confining our attention to those dealing with the therapeutics of the method, we find that there are a few general publications such as those of Dittrich (1), and Strebel (2), (3) in German, and that of Regnier in French (4); together with Finsen's own reports (5), of which only a few stray articles have been translated into English by Sequiera (6). Over and above this, these "Mitteilungen" are exactly what their name implies, disconnected reports and essays upon various phases of the light treatment and subjects connected therewith. My own publications, and those made with Dr. Franklin (7) (8) have necessarily been of similar nature. The rest of the material is scattered about in European, and to a small extent in American medical journals, and is not readily accessible to students.

The numerous inquires that I have received regarding the literature of actinotherapy lead me to believe that a brief résumé of the subject will be found useful. As stated above, I shall omit all considerations as to the nature and effect of the ultra-violet light rays, and the means of employing them; confining myself entirely to publications dealing with therapeutic indications and results.

The employment of the electric arc for therapeutic purposes was first proposed by Friedländer in 1896; but Niels R. Finsen, of Copenhagen, was the originator of the method, and the constructor of the first practical apparatus for the purpose. On the basis of the very marked bactericide action of the violet and ultra-violet spectral regions upon pathogenic organisms on the one hand, and their stimulating and tissue-metamorphosis favoring effects upon the other, he began their employment upon tubercular affections of the general integument, and more especially on cases of lupus vulgaris. This is a very common malady upon the Continent of Europe, and is of the greatest importance from the facts that its most frequent site is the face, that it is extremely chronic and recalcitrant to treatment, and that it often leads to most terrible deformity and disability. So great was Finsen's success that he soon enlisted the assistance of other workers, amongst whom Bie, Bang, Forchhammer, Larsen, and the well-known dermatologist Haslund may be mentioned, in his work. The attention of the Danish government was drawn to it, and it finally rendered him most efficient help. Government subvention and private aid gradually enabled Finsen to extend the field of his operations; and at the present moment he is at the head of a very large and elaborate light treatment institute at Copenhagen, where hundreds of patients from all parts of the world are treated, and which has served as the prototype and model for the various establishments that have sprung up.

The method soon attracted the attention of dermatologists in other countries, amongst whom Strebel, von Ziemsen, Schmidt, Minin, Lindemann, Schüler, Ernst Hellmer, Ullmann, Sjögren, Jersild, Lesser, Gerson, and Max Helm in Grmany, Gaston, Baudouin, Chatin, Leredde, Pautrier, and Du Castel in France, Blacker, Sequiera, and Malcom Morris in England, Veljaminoff and Gelbowsky in Russia, Ginni in Italy, and Ravogli, Stellwagon, and I, in this country, have published the results of their investigations. It has gradually been widened in application, being applied first to the other forms of cutaneous tuberculosis, tuberculosis cutis verrucosa, tubercular ulcer, and post-mortem tubercle; next to lupus erythematosus, held by many to be of similar origin to the former affections; then to ulcers of septic, specific, and traumatic origins: to the parasitic skin diseases, ringworm, favus, pityriasis versicolor, sycosis, and impetigo contagiosa; to inflammations, eczema, acne vulgaris, rosacea: to tumors of unknown origin, carcinoma and epithelioma; and also to alopecia areata, psoriasis, keloid, and naevus.

By almost all of these investigators the employment of the method has been limited to cutaneous and subcutaneous affections; yet it has occurred to more than one of them that it might be found useful in deeper seated troubles. That the tisues and organs are pervious to the chemical rays when of sufficient intensity is proven by transillumination, and also by the experiments which, in conjunction with Dr. Franklin, I published in the Medical Record of April 19, 1902. Little or nothing in the way of practical work has yet been done in that direction, with the exception of the experiments of Hopkins. It seems probable that there is a field for it in the treatment of tubercular and cancerous infections and chronic inflammations of the internal organs.

It will be convenient to consider the various affections in which actinotherapy has been employed in order:

1. Lupus Vulgarus, and Tuberculosis Cutis in its various forms. Finsen himself is of course the great authority on the treatment in these diseases, the number of cases treated in his institute being many times greater than at any other place. But evidence similar to his comes from all parts of the world, demonstrating beyond peradventure that actinotherapy, properly applied, is the best conservative treatment for this entire class of affections. It is not so radical as the excision advocated by Lang and his pupils; nor so rapid as the various cauterant methods so long in vogue; but it has so many distinct advantages that it is the method of election in all cases where it can be applied. In the first place it is sure; all the cutaneous tuberculoses can be cured by its means; and so convinced are some authorities of its certainty in this respect, that they regard its failure as an evidence of a mistake in diagnosis. It is absolutely painless and safe; thousands of cases have now been treated without the occurrence of a single accident; there is no alopecia, no dermatitis, no ulceration. Finally, it is eminently conservative; and this is a point of no small importance when we consider that the face is the portion of the body usually involved, and that young individuals are most commonly affected. The very slightest amount of tissue absorption compatible with the disappearance of the new growth is affected; the ciatricial tissue is often hardly apparent; and all the cosmetic horrors incident to destruction of the skin of the face and to flap or Thiersch transplantations are in that locality avoided.

The last available report of the Finsen Institute dates from 1901 (5); and it is evident from notices that have appeared from time to time in the medical press that its work has greatly increased, perhaps doubled, during the year that has elapsed since then. The total number of lupus vulgaris cases treated (from 1896 to 1901) was 454. In 26 of these treatment was discontinued for various reasons: 10 died (7 from tuberculosis of the lungs, 1 from cancer, 1 from heart disease, and 1 after a laparotomy), 5 stopped on account of advanced tuberculosis of the lungs, and 11 for various private reasons. Of the 428 remaining, 307 have been cured, and 121 were still under treatment at the time that the report was made.

Seven cases of cutaneous tuberculosis other than lupus were treated; 3 of these were tuberculosis cutis verrucosa, of which 2 were cured and 1 stopped treatment. One tuberculous ulceration was still under treatment; and 3 "scrofulous gummata," were apparently unaffected by the applications.

Gaston, Baudouin, and Chatin (10) reported to the French Dermatological Society on 121 cases of cutaneous tuberculosis treated at the Hôpital Saint-Louis by actinotherapy; 78 of these were tubercular lupus, and 18 were tuberculosis cutis and lupus vorax. As is usually the case in dispensary practise, a certain number of these cases disappeared after short periods of treatment; so that only 30 lupus and 6 tuberculosis cutis patients completed the course. Of the lupus cases, 11 were completely and 12 partially cured; in 7 cases there was no result. Of the 6 tuberculosis cutis cases 1 only was cured.

Leredde and Pautrier (11) report on 43 severe cases of lupus vulgaris, 8 of which have been completely and 7 almost cured, while the rest were still under treatment at the time of writing. These were all old cases, in which the most varied remedies had been ineffectually tried in the past.

Ravogli (12) reports a lupus vulgaris of the ear and eyelid, cured in six applications; and a tuberculous ulceration of the back of three years' standing, cured by a longer course of the same treatment.

Blacker and Sequiera (13) at the British Medical Association meeting at Cheltenham report similar good results in this class of dermatoses; and Malcom Morris and other speakers agreed with the reporters.

It would lead us too far to recount all the various articles, and a brief mention of the writers must suffice. Results in these affections entirely similar to the above have been recorded by Gelbowsky (14), C. Ullmann (15), Forchhammer (16), Max Helm (17), Veljaminoff (18), Von Ziemssen (19), Du Castel (20), Schmidt (21), Petersen (22), and many others. The cases cured now number many hundreds, and the method has entirely passed the experimental stage in this class of diseases.

2. Lupus Erythematosus. This is regarded as a tubercular disease in many quarters, and, though I do not believe that this has been at all proven, the results of actinotherapy have been very encouraging in this obstinate and disappointing malady. Finsen reports 31 cases treated, with 11 recoveries; 10 were still under treatment. Leredde and Pautrier (11) treated 23 cases; in 3 there was complete failure; 3 others were improved; in 6 isolated patches were cured; and 11 were entirely cured. These authors give some particulars concerning the previous treatment that these cases had been subjected to, which gives us a good idea of their recalcitrancy, and enables us to estimate the actinotherapeutic results of their true value. They had had 802 galvano caustic seances, 382 scarifications, and 462 high frequency current sessions, without the cure of a single patch.

Ravogli (12) has successfully treated a case of nine years' standing, in which the nose and both cheeks were involved. Gaston, Baudouin, and Chatin (10) report upon 10 cases, with 3 complete and 7 partial cures. Similar experiences are recorded by Helm (17), Leredde (23), Veljaminoff (18), Sjögren (24), and by myself. About one-third of the cases of lupus of this variety are curable by the method. This is by no means unsatisfactory in a malady that is but too frequently entirely untractable.

3. Alopecia Areata. Whatever our ideas as to the etiology of this affection it cannot be denied that while in some cases the baldness remains localized in one or two spots that do not increase beyond a moderate size, in very many others there is a constant tendency to increase in growth of the old and the appearance of new hairless areas. In the beginning it is quite impossible to determine which class a given case will belong to. There is a sufficient basis for the theory of the parasitic origin of some of the cases at all events, and antiparasitic and stimulating remedies have long been the mainstay of the local treatment. Actinotherapy would therefore seem well suited to it; and the results obtained by the few observers who have employed it demonstrate the correctness of this view. Finsen (5) reports on 29 cases, with 22 cures; 1 was still under treatment; and in the remaining 6 treatment had been stopped for various reasons, mostly after but a very few seances.

Bang (25) and Helm (23) report similar good results. I have had occasion to treat only one case by the method, in which I found its action in limiting the peripheral spread of the affection, and stimulating the hair follicles to a renewed and vigorous hairgrowth very satisfactory indeed. Jersild (25), however, has reported the best results. He had 6 cases; in some of them the new growth of hair appeared in ten days, and cure was complete in two months. Others took a longer time, up to eight months; but there were no relapses. To those who are in the habit of dealing with this affection these will seem very satisfactory results.

4. Carcinoma, Epithelioma, and Rodent Ulcer. The data available under this heading are not abundant. Finsen (5) reports on 17 cases, with 8 good and 2 fair results; 7 cases stopped treatment for various reasons. With characteristic caution he records the 8 as "apparent" cures. In a later report by Bie (23) apparently concerning the same cases, 9 are recorded as apparently cured, and some of them had remaned so after two and one quarter years. Leredde (23) reports a case of epithelioma with 8 or 9 seperate foci cured in two months. Sjögren (24) had 10 cases of rodent ulcer and cancroid, 5 of which were cured; the other 5 were still under treatment at the time that the report was made. Blacker and Sequiera (13) reported good results in cancer at the British Medical Association meeting at Cheltenham, August, 1901, and similar testimony is borne by Von Ziemssen (17), Petersen (21), and Helm (17). I have had occasion to use it in one case only of rodent ulcer of the nose. The case was progressing splendidly when the patient, who lived in a distant town up the State, fell into the hands of a local advertising specialist and disappeared from observation.

5. Acne and Rosacea. The Finsen reports deal with 15 cases. of which 4 were cured, 5 greatly improved and 1 still under treatment; the remaining 5 discontinued treatment early. Many of the investigators mentioned above include acne and rosacea among the affections satisfactorily treated by actinotherapeusis; but none give any details save Leredde (23), who cured 3 cases of rosacea that had re-

sisted all other methods of treatment. I have employed it in the suppurative and indurated forms of acne in several cases, but as they were all in young women in whom it was of importance to clear off the face as rapidly as possible, I did not feel justified in neglecting general treatment, massage, curettage, etc, and hence, though the general results were good, I cannot ascribe them wholly to the light. Acne vulgaris, however, would seem to be especially suited to its action. As also,

6. Vegetable Parasitic Diseases, Ringworm, Favus, Pityriasis Versicolor, and Sycosis. Finsen's 2 cases of favus gave negative results; and of 6 ringworms of the scalp in children, only 2 recent ones were cured. On the other hand, Leredde (23) cured a case of chronic sycosis with the light; and Gerson (28) and Von Ziemssen (17) noted good results in ringworm, favus, sycosis, and pityriasis versicolor. The field would seem to be a promising one, though but little has yet been done in it.

7. Naevus. Leredde (23) claims to have had good success in various forms of this affection, as also Bang (25), and Veljaminoff (18). Of Finsen's 10 cases only one was cured; 7 were under treatment at the time that the report was made, and 2 had been discontinued.

8. Eczema. Hellmer (29) reports an extensive pustulo-crustaceous case of two months' standing cured in seven sessions, and Minin (30) got good results in a chronic eczema of the face. Gerson (28) is also satisfied with the method in eczema. On the other hand, Finsen's 5 cases of eczema of the face are all reported as negative.

9. Keloid. Malcom Morris (31) has tried actinotherapy in a case of acne keloid of the breast and back, but does not report on results. Finsen used it in one case with negative results. The prospects of its usefulness in this affection are not bright, but the general hopelessness of other remedial measures would render further trial advisable.

10. Ulcers. Petersen (21) has reported good results in a trophic ulceration, and Gerson (28) in some of septic and varicose origin. The inflammation and suppuration diminished rapidly; by the eighth session the edges had subsided, the fundus had usually cleared, granulation filled the cavity, and cicatrization had begun. I have found it a powerful aid to treatment in sluggish ulcerations of syphilitic and other origin, though, of course, not suited to the more actively inflamed varieties of the affection.

In addition to this the method has been employed in isolated cases of other affections, Psoriasis, Mycosis Fungoides, etc., but not with results sufficiently definite and numerous to permit of reporting.

As stated in the beginning, it has hardly been used at all as yet in the treatment of deeper seated disease. The only reports that I know of are those of Hopkins (32), and Williams (33), on its employment in Pulmonary Tuberculosis. That the good effects of the open air and sunlight treatment in this affection are due in part at least seems probable; and in that case there may be a field for actinic light which is well worthy of cultivation.

In all my cases I have used the Actinolite made by Kliegl Bros., 1393 Broadway, New York City.

144 West Forty-eighth Street, New York City.

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Experiment With Light in the Treatment of Pulmonary Tuberculosis *

BY ROBERT F. WILLIAMS, M.A., M.D., RICHMOND, VA.

Professor of Materia Medica and Therapeutics, Medical College of Virginia.

(*The Dietetic and Hygienic Gazette, October, 1902.*)

My interest in light as a therapeutic agent was first stimulated eighteen months ago by the excellent results that I witnessed from the use of the arc-light bath, with electricity, in a case of locomotor ataxia of several years' standing, and in a case of chronic articular rheumatism, where locomotion was almost lost.

In the beginning of my experiments with light my apparatus consisted of an arc-light bath. This was a cabinet lined with reflectors, in which the patient sat with the head out. In front and behind the patient were placed arc lamps of ordinary power, adjusted with a long arc, so as to develop the violet ray. The temperature of this cabinet in a direct line between the lights was about 105° F. In other parts of the cabinet the temperature was about 97°. Here the patient (nude) was exposed to the rays from one-half an hour to one hour.

The immediate result of the bath was an increase of body temperature from one to two and a half degrees, in spite of profuse sweating, which occurred usually in five to fifteen minutes. The pulse rate was increased and the tension softened. Though sweating was profuse, patients on lying down in a cooling-room invariably expressed themselves as feeling refreshed, though often tired when entering the bath. Other evidence of increased combustion than the rise of temperature was an increase of urea. In all of the early cases treated by this method I had a blood count made, and in all cases in which the count was less than normal a second count was made after two weeks' treatment, which showed in the different cases from twenty-five to forty per cent. increase in the red blood cells. The white blood cells were also increased, though not by so great a percentage.

In connection with the arc-light bath I used ozone, generated by fine electrical sparks from a high-tension coil. This was arranged in a small cabinet, in which the patient sat from five to fifteen minutes. I also used the high-tension current directly on the body. These cases were mostly neurasthenia and anemia, though I also treated two cases of locomotor ataxia. My results with the ataxia were negative, but in the nervous and anemic cases quite satisfactory. The case which I especially wish to report is that of a young man, who gave the following history:

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* Read before the Richmond Academy of Medicine and Surgery, June 25, 1902.

Age, 22 years; occupation for several years past, attendant at a soda-water fountain. He was sent to me in April, 1901, for treatment for gastric catarrh. He gave a history of mild neurasthenia for the previous several years. He also had several times trouble of the middle ear. He responded well to the treatment, and in a couple of months his stomach was in good condition, and his nervous symptoms showed improvement.

About the middle of September he began to feel bad and have a little continuing fever. On September 16 he consulted Dr. Frank M. Reade, who made a diagnosis of pulmonary tuberculosis, and attended him until my return to the city, on September 25 last. His fever was continuous, running as high as 103°. He had some night sweats, some cough, and lost a good deal of flesh. Physical examination showed only a thickening of the pleura at the base of the left lung. On September 29 we had the sputum examined, and the bacilli were found. There was, however, no history of tuberculosis in the family. He was put on increasing doses of cod liver oil and sent to the country, where he stayed for a month. On his return, the sweats had ceased, and he had gained seventeen pounds; but the cough had increased, and, though morning temperature had disappeared, he was running an evening temperature of 100° to 101°.

Physical examination made November 18, on his return, showed the following: At the apex of the left lung and in the interscapular region dulness, fremitus equal to right lung, increased vocal resonance, whispered speech, broncho-vesicular breathing, prolonged expiratory sound, click at the end of forced inspiration, or, in other words, typical signs of consolidation of an area nearly the size of one's hand. The base of the left lung showed dulness to the level of the ninth rib in the scapular line, extending to the front. Sounds of auscultation were diminished over the area. Deep breathing, commanded in the course of examination, invariably caused paroxysms of coughing, which lasted several minutes. These findings were verified by Dr. E. G. Williams and Dr. Frank M. Reade.

Treatment was then begun, consisting of arc-light baths of thirty to forty minutes' duration; ozone inhalations, which at first could be given only five or six minutes, as in that time it produced severe coughing, but which was increased until at the end of a month he could take it twenty minutes or longer without causing paroxysms. For the local stimulating effect I passed a current from the high-tension coil directly through diseased area for twenty minutes.

This treatment was daily. All medication was stopped, his occupation was changed, and he became a collector, under orders to walk at least five miles a day in all kinds of weather. He was also directed to sleep with his windows wide open.

After two days' treatment his temperature became normal and remained so continually. At the end of a month physical examination was again made by Dr. Reade and myself. We thought there was some diminution in the dulness and fremitus over the affected area, but of this we could not be sure. The click on forced inspiration had disappeared, and coughing was not excited at all by this effort. His appetite was excellent.

Dr. H. H. Levy examined him for me at this time, and found dulness, prolonged expiratory note, subcrepitant rales, broncho-vesicular breathing at the apex and upper interscapular region, and friction sounds at the base. I did not have a blood count made at the beginning of his treatment, though from clinical evidence he was unmistakably very anemic. On December 23 a blood count was made on coming to my office by Dr. E. G. Williams, which showed 5,160,000 red corpuscles, 8,700 white corpuscles, and hemoglobin ninety-three to ninety-five per cent. The count was again made immediately after he left the cabinet, when the red blood corpuscles numbered 6,310,000, while the white blood corpuscles showed 9,250. At this time he was leading an active life, and he expressed himself as feeling better than he had in several years.

Physical examinations were made again on January 13 and February 12, at which the signs previously noted were found, though evidently less marked.

On February 15 this course of treatment was stopped, and treatment by Finsen light inaugurated.

My apparatus, called an ACTINOLITE, manufactured by a New York firm,* consists essentially of an enormous arc light, in which the carbons are set at right angles, so as to save loss, the light from which is concentrated by a series of large lenses, giving, when reduced to a small focus, a light approximated at seventy to eighty thousand candle power. The heat from this, which is so great that a cigarette can be lighted in the focus, is cut out by a water-bath, in which I have used methylene blue with best results.

The patient was stripped to the waist and placed about eight feet from the machine, with his back to the light, and the light focused to a circle that would cover the consolidated area, including the apex and upper half of the scapula. The sittings were thirty minutes daily. Ozone and electricity were stopped. Later the patient was reversed, the light being directed on the front of the affected area.

That this light penetrated the lung I demonstrated by an experiment previously made. A negative was placed over the pectoral muscles, and in front of that a sensitive plate, all of which was then covered with material impervious to light. The light was then turned on over the scapula for twenty minutes, when the plate, on development, showed clearly a positive, which could only have been produced by rays passing through the negative after penetrating the body.

On March 19 physical examination showed a practically normal lung, with an occasional friction sound near the apex. In this finding Dr. Levy agreed.

On March 23 bacilli were still present, but the patient coughed only in the morning on arising, while taking deep breathing exercises.

Treatment was continued with gradual lessening of the cough, until the last week in April, when he told me that he had ceased to cough entirely.

About April 25 the sputum was examined, and no bacilli were found. This demonstrated clearly the greater efficiency of the concentrated light in deep-seated organs as compared with the diffused light of the arc-light bath.

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*Kliegl Bros., New York, 129 West Thirty-eighth Street.

About May 17, after great exposure to the sun during the hot spell then on us, the patient complained of malaise, aching in the back, dull headache, etc. Thinking that he had taken cold, I gave him some simple remedy, which relieved the symptoms, except the headache

On Tuesday, the 20th, he sent for me, and I found him suffering with nausea and intense headache through the temples and cheek bones. His temperature was 100° F. He vomited once that day and once the next day. After that continued intense pain through the temples and face, which resisted all forms of treatment, but anodyne and counter-irritant, was the only symptom except earache. On examining the ear, without a speculum, I saw what seemed to be a large piece of wax, which was removed by hydrogen dioxid, but the earache continued two or three days longer.

Dr. H. H. Levy saw him with me about May 26, and while, of course, suspecting meningitis, we concluded that it was a case of cerebral congestion. His temperature by this time was normal. He continued with no other symptoms in this condition until June 3. Treatment consisted of cathartics, potassium iodide, atropine, ergot, ice-bag to the head, blisters to the back of the head and neck, and leeches to the temples and behind the ears. He then developed symptoms of meningitis, spasm of groups of muscles, sluggish iris reflexes, stiffness and tenderness at the back of the neck, intense, agonizing pain through the temples, difficulty or inability to speak. During this time Dr. Reade attended him with me. This condition lasted until June 6, when he died.

Whether the meningitis was of tubercular origin or a simple meningitis from his nasal catarrh, ear trouble, or exposure to the sun, can never be known, as an autopsy was not procurable.

In view of the patient's death, nothing can be claimed as demonstrated, for, if he had lived, I should have considered an interval of many months without return of his pulmonary symptoms as necessary to a demonstration of cure, but from the observations recorded in this case and the reports of other observers, I think the conclusion can at last be reached that it offers great hope in this affliction, perhaps more than any other single line of treatment, and that if perhaps associated with wise medication, as well as hygiene, its development may soon rob tuberculosis of its terror, as antitoxin has done for diphtheria.

The violet rays of electric light as a substitute for cocaine in local anesthesia are used by Professor Minin, the Russian surgeon, who claims for them an antiseptic property also.—*The Medical Times*, October, 1902.

Moller (Allgemeine Medicinisches Centralblatt, Nos. 19 and 20, 1902) has proved that light very rich in ultra-violet rays can overcome the penetration hindrance of the blood.

Sack has investigated the nature of the retrogressive and progressive tissue changes caused by the employment of actinotherapy in lupus, carcinoma, and naevus. His conclusions are that its first effects are upon the blood vessels, endothelial swelling and proliferation occurring. In angiomata there occurs an endovasculitis, leading to final obliteration of the vessels; and the same takes place in lupus. There is never any burning or cauterization; there is no coagulation necrosis. There is no destructive action, as by the cautery; the changes are cellular and elective. Weakening of the pathological element, and strengthening of the normal ones, are the two biochemic results of the treatment, which Muller calls a "cellular therapy." Other methods, like the cautery, destroy healthy with the diseased tissues. The photochemical inflammatory action of the light is more important than its bactericide effect. (Dermatologisches Centralblatt, September, 1902.)

The same author reports on cases of alopecia areata, mycoses of the skin, telangiectases, lupus, and carcinoma cured by the light treatment. (S. Muenchener Medicinische Wochenschrift, Nos. 13 and 14, 1902.)

Veljaminoff (Roussky Wratch, January and February, 1902) reports the cure of thirty cases of lupus vulgaris, nineteen of lupus erythematosus, ten of rodent ulcer, and ten telangiectases by the light treatment. His researches show that the light has a destructive influence on the lower organisms, and on certain tissue elements, such as the giant or lymphoid cells. On the other hand it distinctively promotes the formation of cicatrical tissue.

Bang states that the most refrangible rays, the violet and the ultra-violet, cause a specific skin inflammation, are strongly bactericide, and stimulate the general organism reflectorily. Actinotherapeutic influence may be positive or negative. Negative influence consists in keeping eight of its chemically active elements from the surface of the body, and is employed in various local affections, variola, etc. Positive influence consists in employing the biochemic influence of light on the tissues in various local and general affections. At present, however, only the local method can be regarded as firmly established; the general action of the agent is still in the experimental stage. (Berliner Klinische Wochenschrift, No. 49, 1901.)

Daniloff reports in Therapie der Gegenwart, September, 1902, on the use of the blue electric light in Professor Minin's service at the Military Hospital at St. Petersburg. Twelve cases of neuralgia and neuritic affections were improved or cured. One case was that of a colonel who had had rheumatic neuralgia of the shoulder, worse at night, for nine years. He was cured in nine applications of the light. It also aborted attacks of asthma in twenty minutes in two cases. Daniloff believes that the blue light expels blood from the part exposed, while white light causes hyperaemia.

RIEGELSVILLE, Pa., September 16, 1902.

MESSRS. KLIEGL BROS.

Gentlemen: Your letter of inquiry regarding the results obtained by the Actinolite purchased of you some months ago has been received, and in reply I am pleased to state that I have had it in use almost daily; it has worked without a "hitch," and the results obtained have been most gratifying, particularly one case of lupus of over twenty years' standing, which had repeatedly resisted all ordinary treatment, is responding nicely under the rays from the light.

Yours truly,
(Signed) F. C. GRAY.

Dr. Gray has since the above letter purchased another Actinolite, No. 1, for his new sanitarium at Riegelsville.

New York Homeopathic Medical College and Hospital, Office of the Dean, 64 West Fifty-first Street, William Harvey King, M.D., LL.D.

NEW YORK, September 9, 1902.

MESSRS. KLIEGL BROS., 1393-1395 Broadway, New York City.

Gentlemen: Since the middle of April I have been using the actinic light machine, as manufactured by you, in the Flower Hospital. Our most marked success has been in lupus, and while we have lupus vulgaris in every condition and stage, from slight ones with the ordinary tubercle to those covering the whole face, we have yet to fail in a single instance. I have had occasion to use one or two other lamps; imported ones, but find them much inferior to the one you furnished me.

Very truly yours,
(Signed) W. H. KING.

Robt. F. Williams, M.D., 508 East Grace St.

RICHMOND, Va., September 15, 1902.

MESSRS. KLIEGL BROS., Broadway and Thirty-eighth Street, New York:

The Actinolite that you furnished me last February—No. 1—has been very satisfactory in the main. I have had special interest in the treatment of deep-seated affections (e. g. pulmonary tuberculosis) with it, and am encouraged by the results already obtained.

Yours truly,
(Signed) ROBT. F. WILLIAMS, M.D.

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